BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXIV 1902. No. 2

PHYSIOGRAPHIC DIVISIONS OF KANSAS.

BY

GEORGE I. ADAMS.

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INTRODUCTION.—The eastern portion of Kansas has only a moderate elevation above sea-level, the river valleys being about 750 feet above tide where they cross the boundary. The surface rises to a height of about 4,000 feet in the northeast corner of the State, but the transition is gradual, and mountainous features nowhere occur. Isolated mounds, hills, ridges, and escarpments are the boldest forms of relief, and are conspicuous in contrast with the broader stretches of gentle slopes, rolling prairies, terraced uplands, broad plains and moderate stream valleys. While the topography of Kansas is that of a plains country, it presents an ever-pleasing variation to the traveller, or impresses him anew with its quiet grandeur. The text-book of geology is here so plain that he who runs may read in simple lessons the story of the formation of the earth and the manner in which it has been sculptured into pleasing features. There are no overpowering scenes, and, although there are broad problems, the mind is seldom perplexed when considering that which lies within the range of vision. It may be that this is the reason that the general features of the State have thus far not been outlined. There are many fine descriptions of impressive localities and isolated scenes, but no one has attempted to distinguish the units which constitute the physiographic divisions of the State. Most of them are already well described, but their limits have not been defined or shown on a map. It is the purpose of this paper to indicate as clearly as possible their boundaries and salient characteristics, and to supplement brief descriptions by quotations from the already voluminous literature.

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GENERAL.—The first general physiographic map of the United States published was that by J. W. Powell in the National Geographic Monographs. The limits of the regions are there not closely defined, and subsequent study has shown the necessity of modifying them somewhat. The map of the physical divisions of the United States contained in Davis' Physical Geography differs from that of Powell in certain details, but it likewise is subject to revision. In the accompanying sketch map the results of a closer study of the regions adjacent to Kansas are presented (Fig. 1). It is incomplete in part, especially in failing to show the limits of the regions in the southern portion of Oklahoma. It, however, presents clearly the physiographic relations of Kansas, the features of which it is the purpose of this paper to discuss.

REGIONS REPRESENTED IN KANSAS.—The State of Kansas, with the exception of the extreme southeast corner, which is a portion of the Ozark Region, lies within the Prairie Plains and the Great Plains Regions. These divisions are characterized by their broader physical aspects and their simple geologic structure. They are not clearly defined by topographic differences, although they have a general unity of surface features and altitudes.

THE OZARK REGION.

DEFINITION.—The country here designated as the Ozark Region has been discussed from various standpoints. In the following definition it is considered as structurally related to the Arkansas Valley and the Ouachita Mountains:

> Broadly defined, the Ozark region embraces the southern half of the State of Missouri, a very small corner of southeastern Kansas, the northeastern part of Indian Territory, and the northern part of Arkansas. . . . In a general way the Mississippi and Missouri rivers bound it on the northeast and north, Spring, Grand, and Arkansas rivers approximately limit it on the west and south, while the upper portions of the St. Francis and Black rivers mark its southeastern margin. . . .
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> In its northern portion it is to a large extent a rolling plain, and in its southern and more rugged part the broken character is evidently the result of erosion by streams which have deeply dissected a generally even surface. . . . As compared with the Mississippi Valley, the region is an elevated one. To the north and west of it lie the Prairie Plains; to the east and southeast are the Gulf Plains. . . . The structure of the Ozark region is simple. The Boston Mountains, on its southern border, are of a monoclinal type, while the plateau portion, or northern part, has the form of a low dome, with local faulting and minor undulations. To the south of the Ozark region is the Arkansas Valley region, which has a folded structure, and beyond it the Ouachita Mountain region, which is closely folded and thrust-faulted. . . .
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> In the southern portion of the Ozark region are the Boston Mountains, which are a dissected highland extending through northern Arkansas, from Batesville to near

Wagoner, in Indian Territory. The northern portion of the region is the Ozark Plateau, which consists of two divisions. The eastern one is the Salem upland and the western the Springfield upland. They are separated by the Burlington escarpment. (Adams, Physiography of the Ozark Region, Twenty-second Annual Report, U. S. G. S., Pt. II, pp. 69–75.)

The Division of the Ozark Region in Kansas.

Springfield Upland.—In the extreme southeast corner of the State there is a small portion of the Springfield Upland. Its general surface is a structural plain developed on the Mississippian limestone. The plain is limited on the west by the valley of Spring river, which is located approximately along the contact of the Coal Measure shales. The portion in Kansas is the border of a westward-dipping structural plain, and, lying adjacent to the Cherokee Lowland, is considerably reduced, and has but a slightly greater altitude. The country rock of the Springfield Upland contains much flint. Its surface is accordingly in strong contrast with the lowlands to the west, which are developed on soft shales and sandstones. The limestones, which constitute the upland, contain valuable deposits of lead and zinc. The principal town of the area is Galena.

PRAIRIE PLAINS REGION.

Definition.—The Prairie Plains Region embraces that portion of the Mississippi Valley which lies at a moderate elevation and in which the processes of reduction have brought the surface of the country to a generally level plain. Its surface features have been developed by erosion, and mountainous structures are nowhere present. The changes of level which the Prairie Plains have undergone were relatively slight as compared with the mountainous regions which have been the centres of the disturbances. To the northeast of the Prairie Plains are the Lake Plains, which are related in their development to the Great Lakes. To the south of the Prairie Plains are the Gulf Plains, which have been developed as a result of the oscillations of the Gulf of Mexico. To the east and west the Prairie Plains pass by easy gradations into higher altitudes and into higher plains or plateaux, which are adjacent to the Appalachian Region and the Rocky Mountain Region. It will thus be seen that the Prairie Plains occupy an intermediate position in the Mississippi Valley. Their physiographic history is related to that of the regions on the north, east, south and west. Lying near their centre in southern Missouri, eastern Arkansas and the Indian Territory is an area which has a mountain-

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ous structure. As a result of continuous erosion by streams since the establishment of the drainage system of the Mississippi Valley, the Prairie Plains encroach upon its flanks. Another factor in the development of the Prairie Plains was the advance and retreat of the ice-sheet which covered their northern portions in glacial times, sculptured the surface, and left behind upon its retreat vast accumulations of rock material. This portion of the Prairie Plains is known as the glaciated, in contrast to the southern, or non-glaciated, division of the region.

Divisions of the Prairie Plains in Kansas.

Cherokee Lowland.—To the west of the small area of the Springfield Plain in the southeastern corner of the State there is a belt of low-lying country known as the Cherokee Lowland. This area continues in Missouri, and has there been called the Nevada Lowland; it also extends into Indian Territory along the valley of the Neosho or Grand River, where it merges with the lowland plain of the Arkansas Valley Region. The lowland is developed on the soft shales and sandstones which form the base of the Coal Measures in Kansas. The shales have a thickness of about 450 feet, and are exposed over a belt of country approximately 25 miles wide, within which are situated Cherokee County and portions of Crawford and Labette. In Missouri the area tapers to a point as a result of the overlapping of the higher beds which form its western border on to the rocks of the Springfield Plain.

The surface is gently undulating, the monotony of lowland topography being occasionally broken by ridges and mounds which occur on the divides and owe their existence to heavy sandstones. Such a mound is the one west of Baxter Springs near the territorial line. The country around Columbus exhibits a number of sandstone ridges, the city being located upon the divide between Spring River and the Neosho. . . . The western border of the Cherokee uplands is the Oswego escarpment, which is produced by the first important limestones in the Kansas section of the Coal Measures. This formation is known as the Fort Scott limestone, and at Oswego caps a bed of shales, producing an escarpment which along the river bluff is 120 feet high. (Adams, Physiography of Southeastern Kansas, Kans. Acad. Sci., Vol. XVI, p. 57.)

The surface of the lowland is gently undulating, with watercourses flowing in wide flat-bottomed valleys bordered by low gentle slopes. Toward the western side of the valley outliers of the escarpment bordering the northwestern side relieve the general monotony of the landscape. The whole area is practically down to grade. It is already a lowland of denudation. It has long since passed through its stage of most pronounced relief and is now gradually wiping out the varieties of its surface. On the softer rocks in the vicinity of Clinton the general level is in many places less than 50 feet above the level of the flood plains of the streams. . . . The area of the

soft beds has been exposed to degradation no longer than that of the hard limestones comprising the Springfield structural plain, yet the soft ones have reached old age in the cycle, while the harder ones are in a vigorous youth. (Marbut, Missouri Geological Survey, Vol. X, p. 67.)

IOWA PRAIRIES.—That portion of the division of the Prairie Plains which lies in the northeast corner of Kansas owes its peculiar surface features to the fact that the rock formations are covered with a mantle of drift, deposited during the glacial period. The southern border of the glaciated area is a line approximately along the Kansas River in Kansas and from the mouth of that

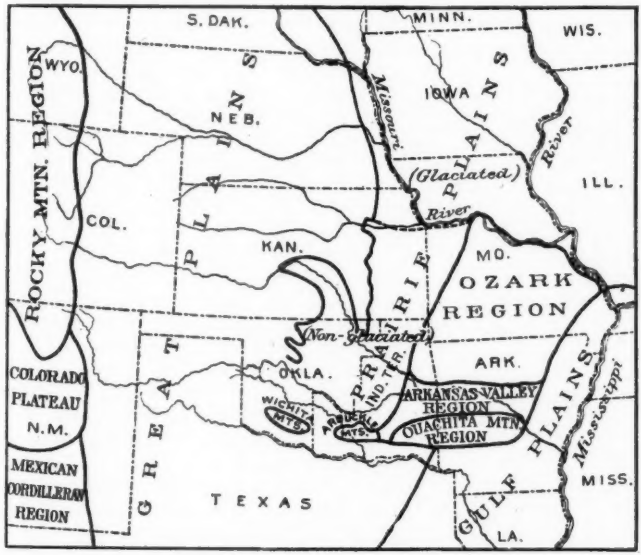


FIG. 1.—SKETCH SHOWING PHYSIOGRAPHIC RELATIONS OF KANSAS, BY GEORGE I. ADAMS.

stream along the Missouri River in Missouri. Since the deposition of the drift the streams have cut their channels deep enough to expose the underlying rock formations and revive in modified form the original topographic features. As a result there are in places fragments of terraces and escarpments similar to those which prevail in the Prairie Plains south of the glaciated portions. No attempt is made to define the limits of the Iowa Prairies beyond the boundary of the State. They extend into Missouri, and find their larger development to the northeast in Iowa.

Northeastern Kansas is the southwestern corner of Iceland—*i. e.*, it is the southwestern part of the area which, in the times immediately succeeding the Tertiary age, was covered with ice. . . .

Where the ice halted and its terminus remained stationary for a time, the melting being exactly met by the supply from the north, there was formed a terminal moraine as a result of the accumulation of the solid matters it had carried along with it. . . .

The true hardpan, or till, is a stiff, pasty dark-brown clay, with pebbles and small boulders. It seems to have been formed under the ice by the grinding of the material over which the glacier passed—clay shales, soft limestones and sands. . . .

The loess is often called bluff, because the bluffs of the Missouri river are formed of it or capped with it. . . . Over immense areas it is substantially the same material as that which gives color and muddiness to the water of the present river. In some regions it takes color from local surroundings, and has streaks of coarse sand or gravel, and becomes of orange brightness. (Hay, 8th Biennial Report State Board of Agriculture of Kansas, Vol. XIII, Part II, pp. 118, 119.)

Boulders lie scattered in small numbers in detached areas, north of the Kansas river, from the Missouri nearly to the Republican, but west of the latter none are noticed. The drift gravel extends a little farther. The origin of our Drift, like all others in the northern hemisphere, must be sought in regions far to the north. No original ledges of quartzite or other metamorphic or igneous rock are found within three hundred miles of the northern State line, and it is only in the western portions of Minnesota that these deposits are represented. No other material of our Drift is found so near. . . .

The larger stones attain the size of true boulders, being sometimes ten feet in length, and weighing ten or twelve tons. The most common are a metamorphic stratified quartzite rock. The metamorphic action has been very thorough, giving the boulders a hardness equal to common quartz, and on that account they are frequently known under the name of "hard heads." . . . The large boulders are usually angular, and not so much water-worn as the small pebbles. Next to quartz rock the most common material is greenstone. A few of granite and syenite are also seen, but seldom as large as the quartzite or greenstone. The deposit of drift material is not deep, being about five feet, though in a few places it is twenty feet. The large boulders are quite numerous on the Pottawatomie Reserve, on both sides of the Kansas. They lie on the tops of the bluffs and high prairies more frequently than on the lower lands. (Mudge, 1st Biennial Report State Board of Agriculture of Kansas, Vol. VI, 2d Edition, 1877–8, pp, 51, 52.)

Osage Prairies.—The Osage Prairies have as their distinguishing features a series of terraces, which have been formed by erosion of the interstratified Carboniferous shales, sandstones and limestones. The rocks have a northeast-southwest strike, and the harder beds, being more resistant, produce escarpments which, with many deviations, follow this direction from the Kansas River into the Indian Territory, although none of them extend unbroken for the whole distance. The resistant beds in Kansas are largely limestones, which outcrop at the top of the escarpments

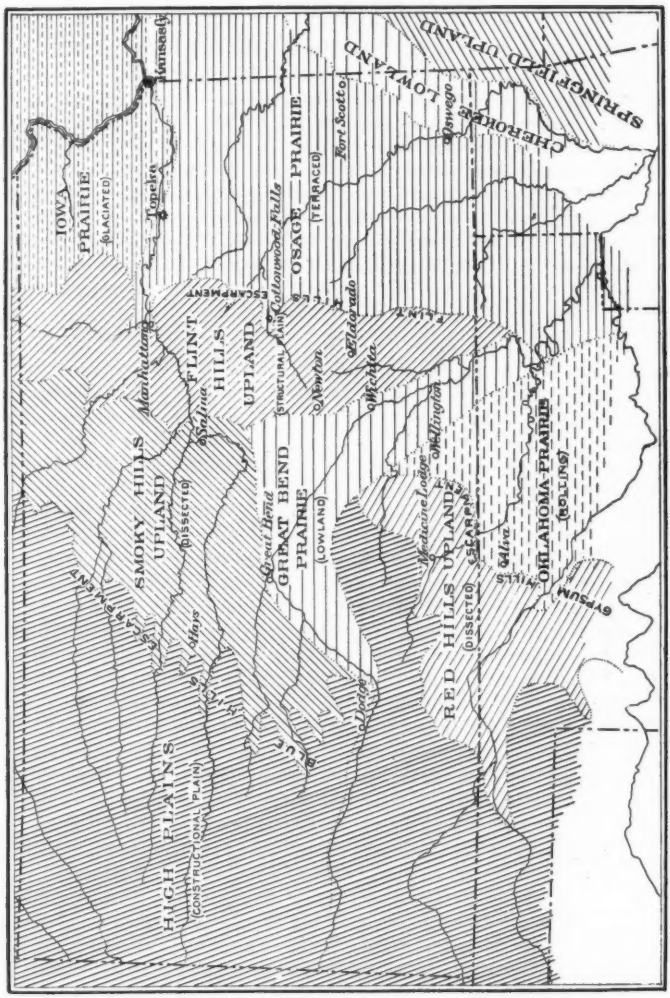
and on the surface of which back slopes are developed. In the Indian Territory the limestones disappear and sandstone formations assume their rôle in the topographic features. The line of transition from sandstone escarpments to limestone escarpments is an irregular V, extending northward from the Indian Territory, with its point approximately at Yates Center, in Kansas.

The drainage of the Prairie Plain is due primarily to the eastward slope of the surface. . . . In general the dip is westward, and the streams flow at right angles to the strike, but slight deformations of the strata have caused a deflection of some of the streams to the southward. . . . The formations over which the streams flow are beds of limestone, alternating with beds of sandstone and shale. The unequal yielding of these materials to erosive agencies has produced in general a terraced surface, the limestones protecting the escarpments, while the shales and sandstones below have been carried away by the streams. The inclination of the strata has produced a gradual slope (back slope) from the top of one escarpment to the base of the next higher. (Adams, Kans. Acad. Sci., Vol. XVI, pp. 56, 57.)

If one passes across the country from southeast toward the northeast he will be continuously passing up a series of terraces. . . . Here and there, wherever there is a line of outcrops of an important limestone, there is a more or less pronounced escarpment facing the southeast. . . . If the escarpment is bold, and the underlying shale bed is thick, a series of mounds always exists to the southeast of the escarpment proper. These have plainly been produced by the erosive agencies breaking through, protecting limestone further to the west. Such mounds sometimes are large, with broad flat tops, as is well illustrated by Table Mound northwest of Independence. Sometimes they have the form of a frustum of a cone, so beautifully illustrated in the vicinity of Cherry Vale and Mound Valley. At other times, as at both these places, the protective limestone is still maintained on their summits. In some instances the surface limestone has been gradually worn away until the material consists entirely of masses of shale, which may have a little sandstone interspersed. In these cases the summit of the mound is rounded. . . . It is interesting to note how the great areas of mounds and escarpments coincide so exactly with the southeastern limits of the shale beds. Beginning at La Cygne and Boicourt we have an area characterized by mounds and steep bluff, reaching to the southwest by way of Mound City, Uniontown, Cherry Vale, and Mound Valley to beyond the limits of the State. [To the west there is] a similar topography in the vicinity of Neodesha and Independence. [Passing further along similar features extend] from Osawatomie to the southwest by the way of Lane, Greeley and Garnett. . . . At Lawrence, Blue Mound stands off five or six miles to the east of the general outcropping of the limestone which forms its protective cap. . . . We find but few rolling areas anywhere within the Carboniferous. The tributaries of the different streams have cut the whole country into valleys, and the residual portions, which have not been carried away by erosion, constitute the hills, so that usually there is such a succession of hills and valleys that the whole country is not only well drained but moderately rugged. While one may travel for miles in the direction of the ridges almost on a level, in a transverse direction deep valleys will be found. (Haworth, Univ. Geol. Surv. Kans., Vol. I, pp. 213–215.)

Oklahoma Prairies.—The sandstone beds, which give rise to heavy escarpments in the Osage Prairies in the Indian Territory, are

succeeded in eastern Oklahoma by softer beds and a succession of formations, which, being generally homogeneous in character, do not


SPRINGFIELD UPLAND
CHEROKEE LOWLAND
IOWA PRAIRIE (GLACIATED)
Topeka
Kansas
Fort Scott
Bonaparte
ESCARPMENT
Kaw
Kansas
Kansas
Kansas

To them the name Oklahoma Prairies is here given. The area is traversed by streams which flow in a general eastward direction, but which are deflected toward the south. The divides are gentle, and no very decided differences of elevation exist throughout the area. The country rock and soil of this area are generally red, and are a portion of what has been called the Red Beds, which are a colour phase of the Carboniferous and Permian formations. The western limit of these prairies is marked by a conspicuous escarpment, known as the Gypsum Hills escarpment, which passes from the Glass Mountains, on the Cimarron river, in Oklahoma, to the west of Alva, and thence into Barber county, Kansas. Only a small portion of the Oklahoma Prairies lies in the State of Kansas. It is triangular in form, and includes the western part of Sumner and Sedgwick counties, and a portion of Harper and Kingman. The line of division between the Oklahoma Prairies and the Great Bend Lowland is naturally not well marked by topographic features, but is drawn relative to the area over which the streams have migrated as a result of the local base-levelling of the Arkansas River.

Great Bend Lowland.—The Arkansas River along its course in Kansas, where it makes what is known as the Great Bend, flows in a shallow channel. Its valley comprises a broad stretch of generally-diversified lowlands, which represent a local base-level of the stream. In this portion of its course the river lies on the easily-eroded Paleozoic shales and the shaly beds of the Dakota formations, and, together with its tributary streams, has, in the course of its meanderings, reduced the country to a generally level plain. The western limit is found along the course of the stream from Larned to Great Bend, where it impinges against the Dakota sandstones. Its southern limit lies in Oklahoma, where the river in passing around the southern end of the Flint Hills, and, eroding its channel across resistant beds, has been confined to a narrow valley. The area of the Great Bend Lowland is largely covered with sandy accumulations, which in places form sandhills, and in other localities are spread out as a thin mantle. The Equus beds in McPherson County belong to this formation. The eastern boundary of the lowland is the line of intersection of the structural plain of the western slope of the Flint Hills with the level country of the Arkansas Valley, and is not strongly marked by any topographic features. It may be drawn with reference to the occurrence of the limestones, on the surface of which the Flint Hills Upland is developed. The Great Bend Lowland, considering its elevation and general surface

features and its relations to the other divisions of the Prairie Plains, is a natural part of them, although it forms an arm extending between the uplands of the Great Plains.*

GREAT PLAINS REGION.

DEFINITION.—The Great Plains Region, or, as it might properly be called, the Great Plains Plateau, lies between the Prairie Plains and the Rocky Mountains, its limit not being marked by sharp differences of elevation or changes in topographic features. It is crossed by a number of streams, which head in the mountains and in their lower portions unite to form the great river system of the Mississippi Valley and the drainage of the western Gulf coast. The Great Plains extend north and south, including the median portion of these streams, and within their area corrasion varies with the varying conditions of climate and the grade of the country. All of the processes which are now at work are dissecting the Great Plains. This has not always been their condition. In Tertiary times the sediments carried from the Rocky Mountains were spread in a broad sheet extending eastward from their base, and built up

* The explanation of the origin of the Great Bend of the Arkansas River, given in the following quotation, was outlined by the writer when in the field, and was subsequently embodied by Haworth in his report.

One of the most notable features in connection with the Arkansas River is the great and unusual bend it makes in passing from eastern Ford County so far to the north to Great Bend, and back so far to the south. . . . It would seem that when the river reached the Dakota formation, a formation so easily corraded, it immediately began acting upon it with great vigor. As the general inclination of the strata of the Dakota is to the northeast, . . . and the Dakota sandstones are easily corraded, it would seem that this was the cause of the river's great bend to the north. We may safely believe that at an early period in the history of the river it passed eastward from Ford County across the north of Kiowa, Pratt and Kingan Counties, probably passing out of the State not far from its present location. If this explanation is correct, one cannot help inquiring why the river did not break through the upland in the vicinity of McPherson County and ultimately join the Cottonwood River through Marion and Chase Counties. To answer this clearly we only have to look at the general geologic character of the southern part of the Flint Hills in Butler and Cowley Counties to find an adequate reason. The great Flint Hills area has its surface rising to points considerably higher than the main uplands of Sumner and Sedgwick Counties. Evidently these high elevations in the early Tertiary times deflected the river southward, and prevented it from crossing the Flint Hills region when the drainage was first changed to an easterly direction by elevations of the Rocky Mountains. The same Flint Hills area has continuously remained higher than the uplands in Sumner, Sedgwick, and adjoining counties. Therefore, with the river once flowing out of the State near where it now does, it would be impossible for it to pass eastward across the Flint Hills so long as the elevations remain as they now are. (Haworth, Univ. Geol. Surv., Kans., Vol. II, pp. 30–32.)

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a constructional plain. This plain is largely preserved to the present time, and constitutes the division known as the High Plains.

The elevation of the Great Plains increases very gradually to the westward, and their surface is not marked by conspicuous features of relief. Their more rugged portions are where the Tertiary formations have been sculptured into bad lands and cañons, or the areas of the older rocks have been dissected by the streams. The Bad Land type of topography is found principally along their western border, the High Plains, or intermediate portion, being simply trenched by the streams crossing it.

Divisions of the Great Plains in Kansas.

The Flint Hills Upland.—This name is here suggested for a somewhat irregular belt of country which extends from north to south across the State and terminates in a point north of the Arkansas River in Oklahoma. It is in its southern part the divide or watershed between the Neosho and Verdigris drainage on the east and the Arkansas drainage on the west and south. The Kansas River is the only stream which crosses the upland. The Cottonwood River heads within its limits near the western border, and flows eastward, extending nearly across the area. The eastern border of the upland is marked by a compound escarpment, which is produced by the outcrop of limestones. This feature is well defined at its southern portion, where it is emphasized by the position of the stream valleys. The removal of the shales, which succeed the highest beds of limestones, has given rise to a structural plain developed on the upper surface of these resistant beds. This plain has a gradual western dip, corresponding to the dip of the rocks, and constitutes the general surface of the upland. It blends along its western border with the Great Bend Lowland and the valley floors of the Smoky Hills Upland. Its southern portion has suffered considerable dissection, and is known as the Flint Hills, from which the name of the upland is derived. The northern portion of the upland is dissected by Little Blue and Big Blue Rivers, which flow southward from Nebraska approximately along the strike of the formations. They have developed well-defined valleys, and their numerous short tributaries have sculptured out terraced hills and divides, producing a quite rugged topography. The Flint Hills Upland has no doubt had an influence in determining the course of the Arkansas River within the State. This stream, after making a peculiar bend, parallels approximately the western border of the

upland into Oklahoma, where it finds it way around the south end. The streams of the northern part of the State have likewise adjusted themselves to the structure of the rocks on the western border of the upland, and joined their volumes in maintaining the valley of the Kansas River across it. In determining the disposition of the drainage from the Great Plains the Flint Hills Upland likewise determined the former distribution of the Tertiary formations by deflecting the streams carrying the sediments, or retarding the velocities of those eroding their channels across its resistant beds and causing them to drop their loads. The eastern margins of the Tertiary formations have been largely removed. Judging from their present extent and relations, as well as the distribution of materials derived from them, we may safely assume that they did not transgress eastward in Kansas farther than the boundary of the Flint Hills Upland. The following description of the Flint Hills, which present the most pronounced characteristics of the upland, is principally from observations along the railway extending from Moline to Winfield, crossing their most broken portion:

The Flint Hills extend in a general north and south direction, and occupy approximately the southern part of Chase County, the western borders of Greenwood, Elk, and Chautauqua Counties, and the eastern portions of Butler and Cowley. Fall, Elk, and Big Caney Rivers, which are tributaries of the Verdigris, have their sources in the many small streams cutting the eastern escarpment of the Flint Hills. The streams on the western slope (structural plain) are tributaries of the Walnut. The Cottonwood, a tributary of the Neosho, sweeps in a broad curve to the north, around the headwaters of the two drainages above mentioned. . . . The divide between these several streams, with its uneven configuration, is known as the Flint Hills. . . . The general position of the ridge may be located on a map by the significant names of the towns—Flint Ridge, Summit, Beaumont, and Grand Summit. In their southern portion, where crossed by this section, the valley of Grouse Creek, which extends from north to south, divides them into two ridges, the eastern of which is known as the Big Flint Hills, and the western as the Little Flint Hills. . . . To the north of the Flint Hills, as here defined, the same geological formations are exposed in the valley of the Kansas River and its tributaries, and give rise to the terraced bluffs which are characteristic of the country around Junction City and Manhattan. . . .

The Flint Hills derive their names from the large amount of flint which is found over their surface. Nearly all the limestones composing them contain some flint, and a few of them carry heavy beds of it. The weathering away of the limestones has left the inclosed masses of flint, which are strewn over the surface in such profusion as to seriously interfere with travel. . . .

The Flint Hills owe their contour wholly to erosion, there being no evidence whatever of marked disturbances of the strata, which occupy nearly horizontal positions [with a low dip to the westward]. They are characterized by even terraces and small canyons and gulches. Along the top of the terraces, which are covered with a scant growth of grass, the various limestone systems are seen in parallel ledges, and are very conspicuous on account of their whiteness. . . . (Adams, Univ. Geol. Surv. Kans., Vol. I, pp. 27, 28.)

RED HILLS UPLAND.—The higher formations of what is generally referred to as the Red Beds in Kansas and Oklahoma contain resistant rocks at several horizons, and erosion has developed within their area a distinctly different surface from what is found in the Oklahoma Prairies. The line of separation between these two divisions is the Gypsum Hills escarpment, already referred to. The topographic forms of common occurrence are small table-like plateaux and flat-topped hills, which are the minor elements. The area is a dissected upland, with its western border grading to the High Plains without perceptible difference of elevation—the rise in surface to the westward being accomplished by a series of steps within the upland. The Red Hills Upland has already been well described by several authors. The following descriptions are particularly applicable to them:

In eastern Barber County, in the buttes to the north of Sharon and the Cedar Hills to the south, the rugged and picturesque country of the Red-Beds begins. . . . This region, with frequent steep buttes and streams lined by steep bluffs, extends across Barber, Comanche and Clark Counties to the eastern part of Meade. The best exposures of the middle portion of the series of rocks forming them, as well as some of the most picturesque parts of this country, may be seen in Barber County, in the Cedar Hills, and along the steep line of bluffs and hills to the west of the Medicine Lodge River, especially in the Gypsum Hills to the southwest of the City of Medicine Lodge. When seen from the hills, to the east of Medicine Lodge, at a distance of ten miles, in the early morning sunlight, they form a landscape of striking beauty, which, once seen, will never be forgotten. The reddish color of the steep sides of the hills, whose walls suggest gigantic fortifications, is clearly visible, while the top of the hills appears in the hazy distance like a great table land. (Prosser, Univ. Geol. Surv. Kans., Vol. II, 84, 85.)

If, on the road from Harper to Medicine Lodge, the traveller finds himself looking westward across the valley of Medicine Lodge River on one of those enchanting days for which southern Kansas yields the palm to no other locality, the autumn air being tinged with just enough of haze to purple the remoter vistas of the ruddy landscape,

"The splendor falls on castle walls,"

which rear themselves seemingly as low mountains or buttressed escarpments of a table land crowning the further incline of the valley and bounding a considerable part of the western horizon. (Cragin, Colorado College Studies, Vol. VI, p. 28.)

The whole country is red. The soil, even where it contains much carbonaceous matter, is ruddy; the sedimentary soil just forming on the steeper slopes is ruddier; flooded rivers glance in the sunlight like streams of blood; steep bluffs and the sides of narrow canyons pain the eye with their sanguine glare. . . .

The hard ledges are persistent for long distances, and give a definite contour to weathered bluffs and ridges. . . . One of these layers south and west of the Medicine river is persistent over a considerable area. The erosion of the valley has left it nearly at the top of the area in which it appears, showing as an irregular plateau

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sloping east and north to the river. . . . In the lower valley the western boundary of the white sandstone plateau is a solid wall of red rock rising above it nearly 200 feet, surrounded by a great white coping of gypsum from 12 to 15 feet thick. The wall runs southward for several miles, with some openings, and terminates abruptly by a turn directly west. Northward its termination is a bold promontory, and the neck, with gypsum absent from it in places, is only wide enough on the top for one person to walk. From this point the wall retreats, forming a deep amphitheatre, with isolated buttes, and towers, and caps, and all up the western valley towers, pinnacles and buttresses are repeated, advancing toward or retreating from the river. When approached, the lights and shadows on the gypsum have the appearance of quaint gables and mansard roofs. (Hay, 8th Biennial Report, State Board of Agriculture of Kansas, Vol. XIII, Pt. II, pp. 106, 107.)

Smoky Hills Upland.—The portion of the State which is included in this division is the north central part. It is so named from the Smoky Hills in Saline County, which have also given their name to the Smoky Hill River. The formations found in the upland are the Upper Cretaceous rocks. The area may be referred to as denuded, considered with reference to the country to the west, which is covered with the Tertiary formations. It is not improbable that the Tertiary beds, which form a constructional plain in the western portion of the State, since the close of the period of their deposition, have been removed by erosion from a large portion of the area of the Smoky Hills Upland. The topographic features are largely of indistinct terrace and broken escarpment type, with occasional lone hills or mounds. Along the southeastern border there are a number of places at which the more resistant sandstone horizons of the Dakota have given rise to features such as Pawnee Rock in Barton County; Smoky Hill Buttes and Soldier Cap Mound in Saline County; and the Pulpit Rocks, resembling perched glacial boulders, at Rock City, Ottawa County. Similar hills and groups of mounds occur in Lincoln, Ellsworth, and Russell Counties, being there also formed by Dakota sandstones. The upland is traversed by a large number of streams flowing eastward in nearly parallel channels and having moderate valleys. The divides between them have a general uniformity of broken slopes and gentle terraces. The rocks which constitute them outcrop principally along the streams as bluffs, and in places form the walls of cañons. The area of the Benton formation is more regular in its topographic features than the Dakota, since it consists of interstratified limestones and shales of a quite uniformly varied character. Toward the western border of the upland the Fort Hays limestone and Niobrara chalk, which succeeds it, are the protecting element in what is known as the Blue Hills escarpment. The Blue Hills proper

are generally considered as occurring in Russell County and extending to the north and south for some distance. The same general feature extends along the entire line of outcrop of the formations, and the name is here extended to the escarpment produced by them. The softer beds of Benton shales underlying the resistant limestones are known as the Blue Hill shales from the same locality. It is the erosion of these beds which gives rise to the escarpment.

Across central Kansas, from north to west of south, stretches a belt of country marked in ravines by rugged sandstone rocks and by long-rounded slopes on the prairie. This belt belongs geologically to the part of the Cretaceous system known as the Dakota formation. To travellers on the Central Branch railroad, passing through Washington and Cloud Counties, these sandstones are conspicuous objects. On the line of the Kansas Pacific, the same sandstones, underlain by colored shales, make the wild country from Bavaria by old Fort Harker to Ellsworth. . . . Further north, in Ellsworth County, are ravines with precipitous sides, on some of which a lost race have carved hieroglyphics of war and travel; and there are huge single rocks, like giant pulpits, standing out and alone. In Russell County are the worn pinnacles and crags of Rock City, and in Ottawa County the quaintly-rounded concretionary masses of another Rock City. . . . (Hay, 8th Biennial Report State Board of Agriculture of Kansas, Vol. XIII, Pt. II, pp. 109, 110, 111.)

THE HIGH PLAINS.—A large portion of western Kansas is included in the High Plains. Their eastern boundary is defined by the Blue Hills escarpment in the northern part of the State. South of the Arkansas River they merge with the undissected western margin of the Red Hills upland. The western limit of the High Plains lies well toward the foothills of the Rocky Mountains in Colorado. Their north and south extent has not yet been defined with any degree of definiteness. They correspond with what has sometimes been called, for convenience, the Central Plains, and form an irregular belt midway in the long eastward slope of the Great Plains. They are characterized by a general dead level surface when viewed in their broader aspect. Their surface is a constructional plain, which has survived in large measure since the close of Tertiary times. The divides between the streams are flats or fragments of an extended surface which was formed by the spreading of a quite even mantle of Tertiary sediments over the older rocks, which are principally of Cretaceous age. The valleys, which are scored into the Tertiary and often expose the Cretaceous, are relatively but slight furrows compared with the broad extent of level land. Along the larger streams, however, are found occasional striking erosional forms, which are all the more conspicuous because of their occurrence in the High Plains. Cretaceous formations, which are exposed where the rivers have cut through the Tertiary

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beds, give rise to cañon walls along the small tributaries, and in the broad valleys remnants of them occur as bluffs and standing rocks. The Dakota is seen at Point of Rocks on the Cimarron River, in Morton County, and the bluffs on Bear Creek, in Stanton County. The Benton and Fort Hays limestones occur along the bluffs of the Arkansas River and its tributaries in Hamilton County. The Niobrara, however, gives rise to by far the more picturesque features. It is exposed on White Woman Creek in Greeley County, at Wild Horse Corral, and at many points along the Smoky Hill River. The Niobrara chalk has the peculiarity of weathering with vertical walls where it is of homogeneous character, so that in many places it has been eroded into picturesque landmarks. Castle Rock, in the valley of the Hackberry, about ten miles from its mouth, is a lone pyramid composed of this rock, and separated by a considerable interval from the main bluff. Monument Rocks, on the Smoky Hill River, are famous landmarks, and formerly a stage station of the Overland Route was located at them. Another picturesque group of rocks, which at a distance resembles the ruins of many castles, is situated west of Elkader in the Smoky Hill Valley. The Fort Pierre shales in Sherman County have been eroded into a number of hills, which are capped with Tertiary conglomerate. In travelling across the High Plains one recognizes the fact that they constitute the typical portion of the Great Plains. The following description is applicable to the High Plains not only in Kansas but in their extent beyond the limits of the State:

> The High Plains, of unconsolidated material, above grade, and exposed to a considerable precipitation, are held by their sod. . . . The great plateau surfaces of the High Plains have to show no systems of drainage, because, presumably, from the commencement of the present erosive stage, they have been sod-covered, as at present. In other words, the High Plains have endured as alluvial plateaux since Tertiary times, or at least since the opening of the Pleistocene.
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> While degradation is at a standstill upon the plateau surfaces, the topographic belt which they constitute has, however, been appreciably narrowed within a corresponding climatic belt by marginal recession. The limiting bluff, especially, that faces eastward, is carried backward by sapping on the part of small streams or feeble beginnings of streams, originating in springs and "seeps" at the bluff foot. . . .
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> Agreeing generally in position with the topographic subdivision of the High Plains is also a subdivision by climatic difference. In their westward rise of thousands of feet the Great Plains pass through climatic gradations from humid to arid. . . . (Johnson, Twenty-first Annual Report U. S. G. S., Pt. IV, pp. 610, 629.)

THE GEOGRAPHY OF CUBA.

BY

T. WAYLAND VAUGHAN AND ARTHUR C. SPENCER.

During the spring of 1901, Dr. C. Willard Hayes was detailed by the Director of the U. S. Geological Survey to take charge of the work of making a geological reconnaissance of Cuba, in compliance with a request made by Brigadier-General Leonard Wood, Military Governor of the Island, and the authors of this paper were assigned as his assistants. Mr. Vaughan accompanied Dr. Hayes from Washington, and together they visited the Isle of Pines, made an excursion in the vicinity of Matanzas, went with pack-train from Matanzas to Cárdenas, and made a trip into the Province of Pinar del Rio, going from Havana to the City of Pinar del Rio, and thence northward to Viñales, in the Organos Mountains. Upon their return to Havana they found Dr. Spencer awaiting them. On April 11th he and Dr. Hayes went by rail to Cienfuegos, and thence by steamer to Santiago. Dr. Hayes remained in the Province of Santiago until April 25th, when he took a steamer for New York. Dr. Spencer continued work in that Province until June 8th. Mr. Vaughan went on April 11th from Havana to the City of Santa Clara, and spent between two and three weeks in Santa Clara Province. On May 4th he arrived in Manzanillo, in the south-western portion of the Province of Santiago, and joined Dr. Spencer at Santiago near the end of the month. On June 8th Dr. Spencer and Mr. Vaughan left Santiago by the Havana steamer. A stop of a few hours was made at Baracoa, whence Mr. Vaughan continued on to Havana, while Dr. Spencer made an excursion in the vicinity of Holguin, and later visited Nuevitas and Puerto Principe.

Acknowledgments are due to Dr. Hayes for the contribution of his observations and for valuable suggestions in the interpretation of the natural features of the island.

The following paper is mostly taken from that portion of the report on the Geology of Cuba treating of the geography and topography of the island, portions being rewritten, others re-edited, so as to make the material suitable for publication in this journal.

One contemplating undertaking geologic or geographic work in

Cuba meets discouragement at the outset, as there is no good map of the island. The best is the eight-sheet map published by the Adjutant-General's Office of the U. S. Army. It is a compilation from various sources, and is extremely inaccurate. The most prominent topographic features are indicated in the roughest manner. Topographic data concerning the island are in general very meagre and are scattered through numerous works, those of La Sagra, Rodriguez-Ferrer, Hill, etc.; and, as careful instrumental surveys have never been made, the information given by these authors is only approximately correct. The coast charts are very unreliable. Often a shoal may exist where moderately deep water is indicated, or the reverse may be true. There is, commercially, an imperative need for careful mapping of the Cuban coast. Under these circumstances no adequate description of the geography of the island is possible, and only an outline will be attempted here.

Although many geologists have visited Cuba, and they have produced an enormous literature, we really know very little of the geology of the island. Our ignorance of the geology prevents us from understanding the origin of much of the present topography, since topography is to so great a degree dependent upon geologic structure and rock character.

The following general remarks concerning size and location may be made:

The island of Cuba extends in longitude from 74° W. to 84° 59′ W., and in latitude from 19° 49′ N. to 23° 15′ N. If Salt Key is included, the coast of the island reaches to 23° 43′. Its length from Cabo Maisí to Cabo San Antonio, measured along the curved axis of the island, is given by Hill as 730 miles, while its width varies from about 90 miles in the widest portion of Santiago Province to about 20 miles across the Province of Pinar del Rio, south of Mariel. The area of the island, exclusive of the outlying islands and keys, is estimated at from 40,000 to 43,000 square miles, while the Isle of Pines is given an area of 1,214 square miles, and the remaining islands and keys are calculated at 1,358 square miles, making the total area of Cuba between 42,500 and 45,500 square miles. The French geographer Reclus gives the area as 45,883 square miles, the Century Atlas as 41,655 square miles, but it is not stated in the latter whether the outlying islands and keys are included.

The surface of Cuba may be divided into five topographic provinces, three of which are essentially mountainous, while the two others are of low or moderate relief. The easternmost of these

topographic divisions coincides approximately with the Province of Santiago, and is for the greater part mountainous. The second, corresponding closely with the Province of Puerto Principe, is made up of plains or rolling open country, broken by occasional hills or low mountains rising above the general level. The third division includes the mountainous and hilly portions of Santa Clara; the fourth comprises the western portion of Santa Clara Province, all of Matanzas and Habana Provinces, and the eastern portion of the Province of Pinar del Rio. This low region, like that of Puerto Principe, is made up of flat or rolling plains, broken by occasional hills several hundred feet in height. The fifth topographic division, comprising the greater portion of Pinar del Rio, is characterized by a prominent range of mountains with its outlying hills and mesas.

The above description of the general topographic features, calling attention to the distribution of mountainous areas at both extremities and in the central portion of the island, classifies the various topographic divisions in a striking and natural way; but since the low regions extend back into the mountainous areas in the interior, and are continued in the form of coastal platforms around the bases of the mountains, the features of the plains cannot strictly be said to be confined to any of the divisions distinguished. It is therefore more convenient to describe the topography of the island without particular regard to the natural topographic divisions.

MOUNTAINS.

Province of Santiago.—The highest mountains in Cuba are situated in the Province of Santiago, where they reach elevations higher than any in the eastern ranges of the United States, and are only slightly lower than the highest peaks in Jamaica and Haiti. The mountainous area in this province is greater than the combined mountainous area of all the other provinces of the island. Its mountains occur in several groups, composed of different kinds of rocks and having diverse structures, but all are more or less closely connected one with another.

The principal range is the Sierra Maestra, extending from Cabo Cruz to the vicinity of the Puerto de Guantánamo, 40 miles east of Santiago Bay. This range is continuous and of fairly uniform altitude, with the exception of a single break in the vicinity of Santiago, where the wide basin which is now partly occupied by Santiago Bay cuts entirely across the main trend of the range.

The hills back of Santiago Bay, separating this basin from the drainage of the Rio Cauto, correspond in structure to the northern foothills of the main Sierra east and west of this break. The slopes of the Sierra Maestra are very uniform throughout, being broken only by the cuttings of the evenly-spaced arroyos. In the western part of the range the mountains rise abruptly from the depths of the Caribbean Sea, but in the vicinity of the City of Santiago and to the eastward they are separated from the sea by a narrow coastal plain which has been locally very much dissected. The streams which traverse it occupy valleys several hundred feet in depth, while the remnants of the plain appear in the tops of the hills.

East of Guantánamo estuary there are mountains which are structurally distinct from the Sierra Maestra, and these continue to Cabo Maisí. They rise at first abruptly from the sea, but toward the eastern extremity of the island are bordered by terraced foothills. Toward the north they are continued across the island as features of bold relief connecting with the rugged Cuchillas at Baracoa and with El Yunque, which lies to the southwest of that town. Extending westward from this eastern mass there are high plateaux and mesas, forming the northern side of the great amphitheatre which drains into Guantánamo Bay.

The most prominent feature of the northern mountains of Santiago Province to the west of El Yunque is the range of mountains comprising the Sierras Cristal and Nipe. This range extends in a general east and west direction, but is separated into several distinct masses by the northward-flowing streams, such as Rio Sagua and Rio Mayarí. The high country to the south of these mountains has the character of a deeply-dissected plateau, the highest strata being massive limestone. It is supposed that all of the mountains in the eastern part of Cuba have been carved from a high plateau, indications of which are seen in the level summits of El Yunque, near Baracoa, and of other flat-topped mountains which have been observed within the drainage of the Mayarí and Sagua rivers. The broad flat summits of the Sierra Nipe are also doubtless a remnant of this old plateau.

Below this highest level several others are distinguishable as benches or broad plateaux. The two most prominent occur respectively at about 1,500 and 2,000 feet above sea-level, according to barometer readings. The highest summits rise perhaps 800 or 1,000 feet higher. The 2,000-foot plateau forms in the Sierra Nipe alone an area estimated to be not less than 40 square miles in extent.

Considering the Province of Santiago as a whole, therefore, the various mountain groups described above form two marginal ranges, which merge in the eastern portion of the Province and diverge toward the west. The southern range is the more continuous, while the northern is composed of irregular groups separated by numerous river valleys. Between these divergent ranges is a broad, undulating plain, the famous Cauto valley, which increases in breadth westward, and opens out toward the northern coast beyond the mountain groups of the northern range. Further westward it merges with the extensive plains of Puerto Principe.

Province of Santa Clara.—The central mountainous region is situated in the Province of Santa Clara. The island is here crossed by a belt of mountains and hills, approximately bounded by northeast-southwest lines passing through the cities of Sancti Spiritus and Santa Clara. Four groups may be distinguished. One of these lies southwest of Sancti Spiritus, west of the railroad from Tunas de Zaza to Sancti Spiritus and east of the Rio Agabama or Manatí. It is a group of ridges radiating from a short axis having a direction from slightly east of north to south of west. A second group is included between the valleys of the Rio Arimao and Rio Agabama. Its highest peak, which is the highest in the central region, is Pico Potrerillo, 2,900 feet in altitude, located seven miles north of Trinidad. The mountains and hills of this group extend northward as far as Manicaragua. A third group, lying to the east and south of the city of Santa Clara, includes the Sierra del Escambray, and the Sierra Alta de Agabama. The rounded hills of this region reach an altitude of about 1,000 feet, although a few of its summits may be higher. The last of the four groups consists of a line of hills beginning at a point on the north coast about 25 miles east of Sagua la Grande and extending subparallel to the northern shore of the island into the Province of Puerto Principe. The trend of this range of hills is therefore transverse to the central mountain zone as a whole, but it conforms in direction with the geologic structure of the region. To the east of the city of Santa Clara the hills of the fourth group merge with those in the central portion of the province. The summits in the northern line of hills are not very high, and it is probable that there is none above 1,000 feet in altitude. The principal members of the group are the Sierra Morena west of Sagua la Grande, the Lomas de Santa Fé near Camajuaní, the Sierra de Bamburanao near Yaguajay, and Lomas de Sabanas Nuevas south of the last-mentioned town.

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Province of Pinar del Rio.—The Province of Pinar del Rio, which is the westernmost political division of the island, is dominated by the Sierra de los Organos. The main sierra of this range lies just back from the north coast and extends from Mariel westward to the Ensenada Guadiana. West of this bay a line of lower mountains or hills forms the axis of the peninsula to Cabo San Antonio, the western extremity of the island. The sierra is flanked by spurs and more or less isolated foothills and buttes. Southwest of Bahia Honda is the highest peak of the range, the Pan de Guajaibón, whose altitude has been variously estimated to be from 1,920 to 2,560 feet. The former figures are probably more nearly correct. Between the city of Pinar del Rio and Viñales the range is broken up into three parallel ridges, the northernmost of which is composed of limestone, the two others being composed of slates, schists, and limestones.

Subordinate Mountains and Hills.—The three mountain groups described above dominate the topography of the island; but in addition to these highlands there are other less prominent groups of mountains and hills rising above the generally level surfaces in the provinces of Habana, Matanzas, and Puerto Principe. These eminences of lower altitude are confined largely to the northern margin of the island, extending with frequent broad intervals of level plain from Habana eastward to Santiago Province.

A few hills rise from the level plain in the western part of Habana Province. These are the extreme eastern outliers of the Organos Range of Pinar del Rio. Other hills lie east and southeast of Habana, being closely connected with a large group northwest of Matanzas, which contains one prominent point, the Pan de Matanzas, reaching an altitude of about 1,300 feet. Some hills occur also between Matanzas and Cárdenas, and at intervals throughout the northern portion of the Province of Santa Clara. In general, these isolated hills or groups have rounded summits, but their lower slopes are frequently very steep, rising abruptly from the surrounding level plains.

The greater part of Puerto Principe is free from hills, the most prominent elevations being in the northeastern portion, where the Sierra de Cubitas contains a few points above 1,000 feet in altitude. To the eastward of this range numerous isolated elevations extend into Santiago, finally merging with the northerly range of that province.

PLAINS.

Aside from the mountains and hills above described, the general surface of Cuba is that of a rather low, gently undulating plain.

In Pinar del Rio a piedmont plain entirely surrounds the Organos mountain range. On the south it has a maximum breadth of 20 miles, and ascends gradually from sea-level to the base of the mountains at the rate of 7 or 8 feet to the mile. Its seaward portion is extremely flat, but as the highland is approached it becomes more undulating and somewhat deeply dissected by stream channels. North of the mountain range the lowland belt is much narrower and also somewhat higher. It does not have a regular slope to sea-level, but is at least 200 feet high near the coast. It is deeply dissected, so that in places only the level hilltops mark the position of the plain.

The northern and southern piedmont plains of Pinar del Rio unite at the eastern extremity of the Organos Range and extend eastward over the greater part of Habana and Matanzas provinces and the western part of Santa Clara. Although the divide between northward and southward flowing streams is approximately on the axis of the island, the plain has a gradual southward slope from near the northern margin. In the vicinity of Havana its elevation is between 300 and 400 feet, and eastward to Cárdenas, wherever it can be recognized, it varies between those limits; that is to say, the northern edge of the island appears to have been elevated about 350 feet more than the southern edge. The northward-flowing streams have lowered their channels as the land rose, and the portion of the plain which they drain has thus been so deeply dissected that in many places only the level hilltops attest its former extent. The southward-flowing streams, on the other hand, have been scarcely at all affected by the elevation, and remain generally in very shallow channels. Eastward from Cárdenas the general elevation of the plain is less, and it slopes gradually both north and south from the axis of the island. Considerable areas of the plain are developed among the various mountain groups which occupy the eastern half of Santa Clara Province, and beyond these mountains it extends eastward over the greater part of Puerto Principe and into Santiago. In this province it reaches the northern coast between isolated mountain groups as far east as Nipe Bay, and to the southward merges with the Cauto Valley. From Cabo de Cruz the plain extends along the northern base of the Sierra Maestra to the head of the Cauto Valley. Its elevation near Manzanillo is about 200 feet, and it increases to about 630 feet at El

Cristo. In the central part of Santiago Province the Rio Cauto and its tributaries have cut channels in the plain from 50 to 200 feet in depth. In the lower part of the valley these channels are sometimes several miles across, and are occupied by alluvial plains. They decrease in width toward the east, and in the upper part of the valley they are narrow gorges.

Much of this plain, particularly in the central provinces, is underlain by porous limestone, through which surface waters readily find underground passages. Hence over large areas flowing surface streams are entirely absent. The rain-water sinks below the surface of the ground as soon as it falls, and, after flowing long distances in subterranean channels, often emerges in bold springs, such as those which form the Almendares River, in the vicinity of Havana.

The surface of the plain over large areas is covered by deep, residual clays, derived from the slow wasting of the underlying limestone, and forming both red and black soils of great fertility. The soils of the vast sugar plantations of the provinces of Habana, Matanzas, and Santa Clara are mostly red soils of this nature. Certain portions of the plain, such as that bordering the mountains of Pinar del Rio on the south, are covered with a layer of sand and gravel derived from the adjoining highlands, and their fertility is greatly inferior to the soil derived from the limestone. Similar superficial deposits occur in the vicinity of Cienfuegos, and doubtless in many other portions of the island where the plain forms a piedmont adjacent to highlands in which silicious rocks occur.

TERRACES.

Terraces form an extremely characteristic feature of a large portion of the Cuban coast. They occur along the whole of the north coast and along the south coast in Santiago Province, but west of Manzanillo, along the south coast, they are inconspicuous or are entirely absent. These terraces give very important data regarding the geographic and geologic development of the island; but no detailed description of them will be attempted here.

Westward of Havana the conditions for the preservation of the terraces have not been good. However, in the vicinity of Mariel remnants of a raised coral reef at an elevation of about 150 feet have been observed, and a lower, much more recent, terrace, about 5 feet above tide, is of general occurrence. Four terraces may be recognized at Havana at 200, 100, 10–15, and 4–5 feet. The highest level is underlain by an elevated coral reef, containing Upper Oligocene fossil corals. The lowest terrace, wherever observed, contains

species of living reef corals. At least six terraces, and probably more, can be recognized at Matanzas. The highest stands about 400 feet above sea-level. A level at 200 feet is very extensively developed, its area being miles in extent.

Along the south coast there are at Manzanillo at least three levels at 200, 100, and 5–20 feet. At Santiago there are eight, the highest being about 400 feet in elevation. Dr. Hayes distinguished at least seven levels at Cabo Maisí, three being more prominent than the others; the distance in elevation between the highest and lowest was estimated at 600 feet. These facts show a divergence in elevation of the terraces as one goes eastward, indicating greater elevation of the eastern end of the island.

Since numerous writers have spoken as if the high terraces at different localities along the Cuban coast were formed of Pleistocene or modern reef corals, we desire to state that at no point sufficiently studied by us did Pleistocene reefs occur at elevations exceeding 30 feet or 35 feet. The fossils in the higher terraces are Upper Oligocene, as fairly large collections made at Santiago and smaller collections made at other localities show. At Santiago the lowest terrace alone contains Pleistocene corals, and this rises only a few feet above the level of the sea. The higher benches are thought to be terraces cut in the Tertiary and older rocks of which the island is composed.*

DRAINAGE.

The arrangement of the streams in the greater part of Cuba is extremely simple. Excepting in the southwestern portion of Santiago Province the stream courses are practically all normal to the coast. Owing to the shape of the island, therefore, none of its streams have any considerable length or volume; they are, however, very numerous, and nearly 200 enter the sea.

The divide between the northward and southward flowing streams follows near the axis of the island, but is generally somewhat nearer the north coast. In Pinar del Rio the divide is formed by the crest of the Organos Range. Wherever this range is composite the divide is generally upon the southern crest—that is, the northern portion of the range has been more deeply eroded and the divide has been pushed to the southward of its axis. Throughout the four central provinces the divide is, for the most part, extremely indefinite, being simply a level plain, on which there is no sharp water-parting.

* Drs. Hayes and Spencer saw eastward of Santiago, over the older formations, a veneer of limestone, which they consider of possible Pleistocene age.

Owing to the southward tilting of the plain the northward-flowing streams occupy deeper channels than those flowing to the southern coast. In general, the drainage of this central portion of the island may be described as autogenous—that is, the stream courses are such as would be formed on a gently undulating plain recently raised above sea-level. No considerable subsequent adjustments are observed in the main streams, although some of the upper stream courses are closely adjusted to structure. This is particularly noticeable in the central part of Santa Clara Province, where the streams occupy the outcrops of certain soft beds between harder strata on the sides of synclinal folds. A similar adjustment upon the sides of an anti-clinal fold is seen in the Yumurí Valley, near Matanzas.

The drainage of Santiago Province affords some exception to the normal arrangement elsewhere observed. The Cauto River flows through the centre of the province in a broad westward pitching syncline. It is, therefore, a consequent stream, its position being determined by the structure of the underlying strata. Its northern tributaries head upon a low divide similar to that throughout the central provinces, but its southern tributaries head upon the northern slopes of the Sierra Maestra and flow northward directly away from the coast. To the eastward of Santiago City the streams have courses normal to the coast, although there is little regularity of arrangement, owing to the mountainous character of this region. Many of the rivers flow outward from the centre of a syncline and cut directly across the edges of upturned strata. These are doubtless antecedent streams, and it is only in their upper courses that adjustment to structure is to be expected.

HARBOURS.

Cuba is noted for its splendid harbours, and nearly every author who has written on the physical aspects of the island has devoted considerable space to their description. The best harbours, excepting that of Matanzas, are pouch-shaped, possessing a narrow entrance separating a large, nearly circumscribed inland body of water from the sea. The harbours of Havana, Cienfuegos, and Santiago are the most important, and all belong to the same type.

The entrance to the harbour of Havana, between the Morro and Castillo de la Punta, is very narrow. The harbour itself is dumb-bell-shaped, arroyos that empty into it determining its outline. The Morro and Fort Cabañas are situated on the northeastern side; Regla, with its warehouses and wharves, is on a projection on the

eastern side; the southern end is shallow, having been filled by sediment brought down by several streams. The city of Havana is situated on the western side, extending south from the Castillo de la Punta to the southern end of the harbour. The water in its channel and central portions is deep enough for the deepest-draught vessels, but only shallow-draught vessels can be accommodated at the docks.

Careful borings which have been made across the entrance to the harbour by the Military Government, in connection with the preparations of plans for a sewerage system, point to the existence of an old channel in the middle of the present channel. This is now filled with sand, but it certainly at one time afforded a free outlet to the sea at a level considerably below the present bottom of the harbour.

Other important harbours on the northern coast are Bahia Honda, Cabañas, and Mariel, in the Province of Pinar del Rio; Matanzas and Cárdenas, in the Province of Matanzas; Nuevitas, in the Province of Puerto Principe; Gibara, Bahia de Nipe, and Baracoa, in the Province of Santiago. All of these are pouch-shaped excepting that of Matanzas, which has a broad entrance.

Good harbours are not so abundant on the south coast as on the north. The most easterly one is that of Guantánamo. It is a fairly good pouch-shaped harbour but rather shallow. The next one toward the west is at Santiago, which is one of the finest in the world. There is no noticeable indentation of the coast-line excepting immediately in front of the entrance, which is only 180 yards across and is cut in a steep seaward escarpment over 250 feet in height. On the eastern side of the entrance is the Morro, its lighthouse rising 310 feet above sea-level, or about 40 feet above the point of land on which the fort stands. On the western side of the channel the sea scarp is less abrupt and regular, the land rising from the sea in series of low hills. The island Cayo Smith lies just within the harbour, to the west of the main channel. On the eastern side are precipitous cliffs rising to a height of 200 or more feet. Cayo Smith and the high land on each side of the sinuous entrance completely conceal the broad expanse of the harbour proper from the sea. North of Fort Socapa, now in ruins, on the eastern side of the harbour, is the narrow entrance to Nispero Bay, a beautiful land-locked harbour deep enough to accommodate the largest man-of-war, and in which the Military Government has built a dock. The depth of water in the channel and in the greater part of Santiago harbour is sufficient for the largest vessels, but only light-draught vessels can come up to the docks. On the northern and northeastern sides of

the harbour the land rises less abruptly than on the eastern side, and there is a succession of terraces from sea-level to an elevation of 200 feet. It is upon these terraces that the city of Santiago is built.

The harbour of Cienfuegos is very similar to that of Santiago, except that the land on each side of the entrance is not so high.

Other harbours on the south coast, as Manzanillo and Batabanó, are merely open roadsteads, generally shallow and more or less perfectly protected by the numerous sand keys which abound along the coast from Cabo Cruz to the western end of the island.

Various explanations of the pouch-shaped Cuban harbours have been made by several writers. These need not be given here, but the explanation which appears to us most satisfactory may be briefly stated.

The depressions occupied by the water of these harbours appear to be due entirely to erosion by streams flowing into the sea during a very late geologic period, when the land stood somewhat higher than now. In other words, they are drowned drainage basins. Their peculiar shape, a narrow seaward channel and a broad landward expansion, is due to the relation of hard and soft rocks which generally prevails along the coast. Wherever the conditions are favourable for the growth of corals a fringing reef is built upon whatever rocks happen to be at sea-level, and as the land rises or sinks this reef rock forms a veneer of varying thickness upon the seaward land surface. The rocks on which this veneer rests are generally limestones and marls, much softer and more easily eroded than the coral rock. Hence several small streams, instead of each flowing directly to the sea by its own channel, are diverted to a single narrow channel through the hard coral rock, while they excavate a basin of greater or less extent in the softer rocks back from the coast.

The fact that the land has recently stood at a sufficiently higher level to enable the streams to excavate such basins is proved by the sand-filled channel in the Havana harbour entrance and by borings made near the mouth of Rio San Juan at Santiago. Doubtless similar-filled channels would be discovered in the other harbours of this class if they were explored by boring.

It is interesting to note that at various points along the Cuban coast precisely similar basins are now being excavated which would form pouch-shaped harbours if the land should be slightly depressed. Several of these were observed eastward from Santiago. If the coast at Matanzas were to sink thirty feet or more a portion of the Yumurí valley would be flooded, forming a broad land-locked basin connected with the sea by a very narrow channel in the present Yumurí gorge.

THE TIDES IN THE MIDST OF THE PACIFIC OCEAN.*

A STUDY BY

ALEXANDER BROWNLIE.

3. The Time of High Water in the Midst of the Pacific.

Under our third head we will consider the question of the time of high water in the midst of the Pacific. According to the rules, when the moon is new or full at a small island in the midst of the ocean, then high water ought to take place there at noon and midnight—when the moon is new or full in the meridian of Apia, then precisely at noon and midnight tide ought to rise to its highest level. But what are the facts in the case? The facts are the opposite, for instead of high water taking place at noon and midnight, it is low water at these hours! For example:

APIA, JANUARY, 1900.

MOON'S PHASES.	DAY OF MONTH.	TIME OF HIGH WATER.	
New	1	6.20 A.M.	6.35 P.M.
1st Quarter	7	11.38 "	
Full	15	6.30 "	6.39 "
3d Quarter	23	11.42 "	
New	30	6.04 "	6.21 "

The table shows that the time of high water at this station, right in the midst of the Pacific, does not take place in conformity with the rules of the science; and were we to consult tables for the years 1898 and 1899 we should find that nature constantly disregards the rules at Apia. That fact is the more significant because promoters Airy and Whewell removed the residence of lunar attraction from the Equator to the Southern Hemisphere. Now, Newton himself had placed its residence at the Equator; therefore the removal was a new and very extraordinary departure in the doctrine.

The reason why they removed it from the centre of the earth to a siding, as it were, was on account of a little discovery made by Capt. Nathaniel Bowditch, the self-taught American mathematician

* Concluded from page 25.

and the translator of the Mécanique Céleste of Laplace. He began to observe the tide through his own eyes as well as through the eyeglass of mathematics. Upon taking observations at the Equator he was surprised to see ebb tide occurring at noon, at time of new moon and full, instead of flood tide. The surprise was the greater because Newton predicted that, when tides were observed at the Equator, his science would be found correct!

When Bowditch discovered that it was all wrong, he said: "It is a remarkable singularity."

But after that remarkable discovery, then, of course, the removal was inevitable, hence the origin of the new departure in the doctrine.

We will next consider the question of the time of high water at Honolulu.

HONOLULU, JANUARY, 1900.

MOON'S PHASES.	DAY OF MONTH.	TIME OF HIGH WATER.	
New	1	3.50 A.M.	3.50 P.M.
1st Quarter	7	8.04 "	10.06 "
Full	15	3.47 "	3.58 "
3d Quarter	23	8.02 "	10.55 "
New	30	3.30 "	3.42 "

The tables prove that the time of high water right in the midst of the Pacific does not conform to the rules of the science; in short, the facts disclosed at Honolulu and Apia show that nature constantly denies the claims of the science.

4. What is the Rate of Tidal Speed in the Midst of the Pacific?

Under our fourth head we will consider the question of the rate of tidal speed. But, first of all, we must listen to the dictum of the advocates of the science:

> The earth takes 24 hours 50 minutes to turn around with respect to the moon; that is the time which the lunar tide wave takes to complete the circuit of the earth. . . . . The sun completes the circuit of the earth in one day. Therefore, the solar tidal influence travels over the surface of the earth at the rate of 1,042 miles an hour.—*The Tides*, page 165.

Hence, in accordance with the theory, there are independent sets of lunar and solar waves travelling around the globe trying to keep up with sun and moon, but the rate of speed in each set is different; the sun waves more faster than the moon waves.

In his argument for the 1,000 mile an hour rate the author, quoted above, figures on a depth of 13¾ miles. But no such deeps in the ocean are known to science. Many soundings, however, have been taken in the Pacific, Indian, and Atlantic Oceans at a depth of three miles and over. Continuing his argument, he figures again that a three-mile depth will permit a speed of 500 miles an hour. But the reduction of the rate from 1,000 to 500 miles an hour produces a hitch; for then the thing produced can only travel half as fast as that which produces it, and thereby the theory becomes an absolute failure.

In order to test the lower rate of speed at the lesser depth, if such a rate exists, we ought to discover the evidence of it in the midst of the Pacific. The modern advocates affirm that the seat of tidal energy is located in the South Pacific, and that from thence the world is supplied with its tides: that from thence they not only sweep from east to west, but from south to north. If they sweep from south to north, then, since Apia is separated from Honolulu by 35° of latitude, the 500 mile an hour wave ought to travel that distance in less than five hours.

But what are the facts in the case?

On Jan. 1, 1900, Apia had first high water at 6.20 A.M.
" " " Honolulu second " " " 3.50 P.M.

(Of course, we have seen already that the second high water was only an apology for one.) The apparent difference in time is not five hours, but nine and a half hours.

A still clearer case of the absolute failure of the speed of the theory is disclosed at the islands of Tahiti and Tubuai. These islands are situated on the same line of meridian, and have precisely the same moon-time, but there is a difference of about 3½ hours between their times of high water! This fact is all the more striking because the islands are located in the immediate neighbourhood of the supposed tidal energy. In fact, it may be said of them that they lie in the very cradle of the tides.

Another remarkable case occurs at Easter Island, and the island of Sala y Gomez: between this pair the difference in the moon-time is only 15 minutes, but the difference in their times of high water is 3 hours 19 minutes!

Before such geographical evidence the mathematician's argument goes down like a row of bricks set up on end.

If such a speed as 500 miles an hour existed in the midst of the Pacific, the flood tide would visit the islands of that ocean suddenly, and with destructive force.

It is idle for the promoters to talk of a natural *brake* placed upon their great speed by oceanic shoals, because on the east side—the side facing the widest expanse—Japan rises abruptly from one of the deepest depths of the Pacific, from a depth of 3,950 fathoms—about 4½ miles! The shores of Honolulu also rise suddenly from the depths of 2,225 to 2,875 fathoms, yet from such abysmal deeps flood tides, at times, are exceedingly slow and vacillating! It is also useless for Prof. Geikie * to tell us that

its rate in the Atlantic is 500 geographical miles an hour. But as this is merely the passing of an oscillation, the particles of water are gently raised up and let down again.

Such a speed as that in water does not manifest itself by gentleness! If it existed, then it would manifest itself both to the ear and to the eye at the islands in the midst of the Pacific, and also upon our own shores.

Lastly, if we look at the question of speed from a commercial point of view, there would be no commerce; if from a geographical, no land could resist the pounding of such waves; if from an actual point of view, no such speed has been observed by man, for no such speed is possible in water. In fact, we doubt if Niagara itself, in the perpendicular plunge of 150 feet from brink to chasm, comes up to the promoter's rate; yet his rate moves *sideways* to the lifting power, and not directly, like falling water. So enormous a rate as his is non-existent, except in his own mind; but in that region it has been known to exist for two centuries!

This whole question of speed is naught but a "study in contradiction."

5. What the Tides in the Midst of the Pacific Teach Us.

In entering upon the consideration of the question under our fifth head, perhaps the clearest answer can be given by a brief review of that which we have learned, step by step, in our study of the tides in the midst of the Pacific. That study teaches us that

(*a*) The established fact of enormous irregularity in the North Pacific in its time-intervals discredits the assumption of lunar attraction.

(*b*) The established fact of the differences in the daily amount of supply challenges the claim of lunar attraction.

(*c*) The established facts in the daily distribution of supply deny the claim of lunar attraction.

(*d*) The established fact that men ignorant of the science made

* Article Geology, Vol. X. Encyclopædia Britannica, page 283.

"remarkably correct" forecasts proves that a knowledge of the science is not necessary to the forecaster at all, when making a tide almanac.

(*e*) The established fact that tides act in direct opposition to the rules at the Equator, proves that Newton erred as a predictor and based his science upon error.

(*f*) The established fact that tides act in direct opposition to the rules at Apia shows that the promoters unwisely removed the residence of lunar attraction to the neighbourhood of Apia.

(*g*) The established fact of the failure of the second flood tide at Honolulu establishes the failure of the doctrine of equilibrium. "The form of equilibrium is unattainable" (*The Tides*, page 151).

(*h*) The established fact of a gentle tidal speed in the midst of the Pacific proves that the speed of the promoters is merely a delusion.

(*j*) Finally, the science of Newton is as valueless to explain the problem of the tides of nature as the scheme of Ptolemy was valueless to explain the problem of the starry heavens. But we now turn our back upon this lunar tidal anarchy and proceed to discourse about the power which dominates the tides.

6. By what Power is Flood Tide Lifted?

When we were considering our second head we saw that correct forecasts cannot be made by the knowledge of a supposed globe travelling wave. On the contrary, they can only be made from a local knowledge. That fact being established, then we maintain that the force which lifts tide is *local*, that it belongs to the mechanics of the earth and not to the mechanics of the heavens; that the power dwells *within flood tide* itself. It is an established fact that regions of high-water-level in the ocean are contiguous to regions of low water level; hence the region of high-water-level must move towards the region of low water level because of the common law of gravitation which governs the movements of water not only upon the land but in the midst of the sea. The movements of tide are operated by the opposition of high and low level in contiguous regions. The driving-power developed *within* a region of high-water-level, when standing at high, is the driving power that lifts flood tide. The region of high level must move towards the region of low level by gravitation, and the momentum of the movement does not become exhausted until the low level is forced up into the condition of high level. Every time a region of high

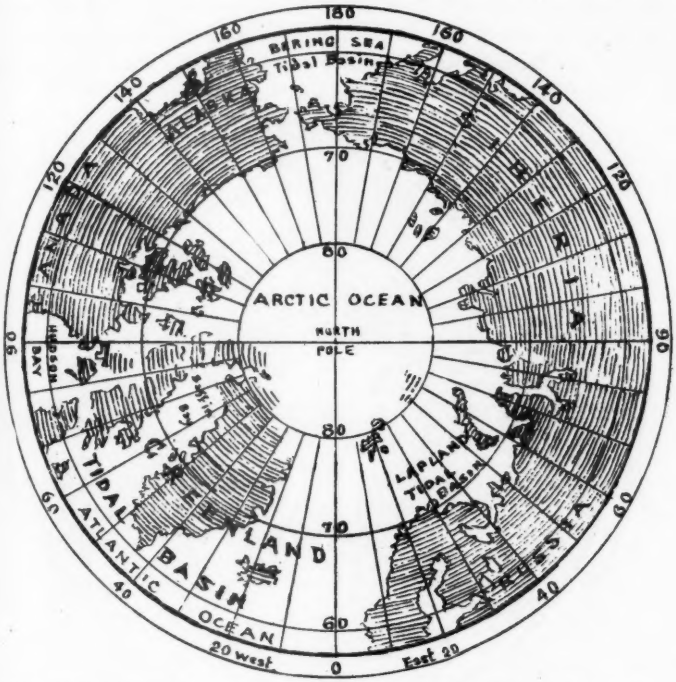
level is attained then the driving power is renewed and developed *within* itself.

But it may be asked, How could such a mechanical system originate? We answer, That question does not come into the present inquiry. This inquiry extends only to the *observed facts* in the tides of nature. But if it did extend to the philosophy of the case, then we in turn would ask our esteemed friends the promoters to explain the origin of their lunar system. How did the moon lift the first tide? And also to furnish a chart of the 1,000-mile-an-hour waves round the earth. They ought to produce the chart to prove that moon-time, and time of flood tide agree around the globe, for that is a first principle of their science. On our part we observe the facts and then try to explain them; observation comes first, not last!

For instance. When we see that the pressure is about evenly balanced between contiguous regions then we say that the time-intervals will be more regular in each, but when unequally balanced, then the time-intervals will be irregular—as irregular, for instance, as those in the North Pacific. That deduction immediately raises the question: Why are the time-intervals so irregular in the North Pacific? The answer is not far to seek provided we make it also a geographical question. Then it will be seen that the cause is both geographical and mechanical combined. Of all the great oceans the North Pacific differs from the rest in one very important aspect, viz., in its *isolation* on the north side. Upon that side it is almost completely landlocked and shut out from communication with the Arctic Ocean. Therefore on its north side the balance of power is absent. On that side there is hardly any tidal pressure at all, and the little there is dribbles in through one small *deep* opening from a deep place of an otherwise comparatively shallow sea—Bering Sea—which in its turn filters through the narrow, shallow Bering Strait on the extreme north, whereas on the south side it has no land boundary whatever; therefore the pressure upon the south side is exceedingly powerful as it moves with majestic force across the open, wide equatorial belt, but the delivery of flood tide there is lopsided because delivered at *different* times from different basins; hence causing the great irregularity in the time-intervals. The mechanical action, however, is a *single-pressure* action, *i. e.*, pressure on one side only—the south side.

That our conclusion is reasonably correct, and our argument logically sound, we will show by a comparison of the land boundaries of the North Atlantic with those of the North Pacific; the former

has no land boundaries on the north shutting it out from communication with the Arctic. On the contrary, it has two large openings, one of which is very wide—over 650 miles wide, and by means of these openings the balance of power is maintained by the mechanical tidal principle of *double pressure*. When the northern region

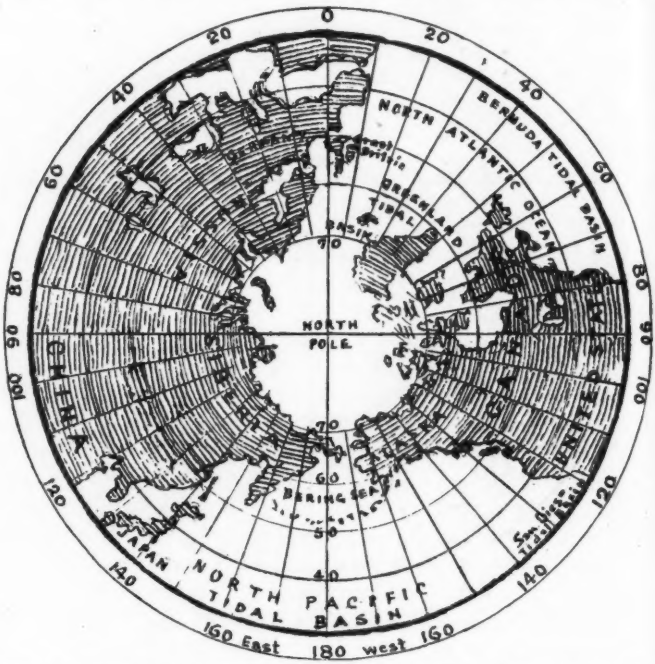


SKETCH MAP SHOWING OPEN COMMUNICATION BETWEEN ARCTIC OCEAN AND NORTH ATLANTIC OCEAN: RESULTING IN REGULAR TIME-INTERVALS FROM ONE HIGH WATER TO THE NEXT.

(Greenland tidal basin) has reached its highest level, then its waters press as strongly to the southern low level as they do to the northern; hence open communication between basins produces regular time-intervals in the North Atlantic. When we look at tidal differences from a geographical point of view, then it is clear that that view gives the clue to the *cause* of the *variation* in time-intervals and establishes the fact that there are *varieties* of tides. For *open* communication in the North Atlantic produces regular time-intervals, whereas *closed* communication and irregular delivery in the North Pacific produce irregular time-intervals and a separate

variety of tide. Therefore the pattern of tide in the North is absolutely separate from that in the South Pacific. Moreover, if our explanation is correct, then the tidal problem is solved.

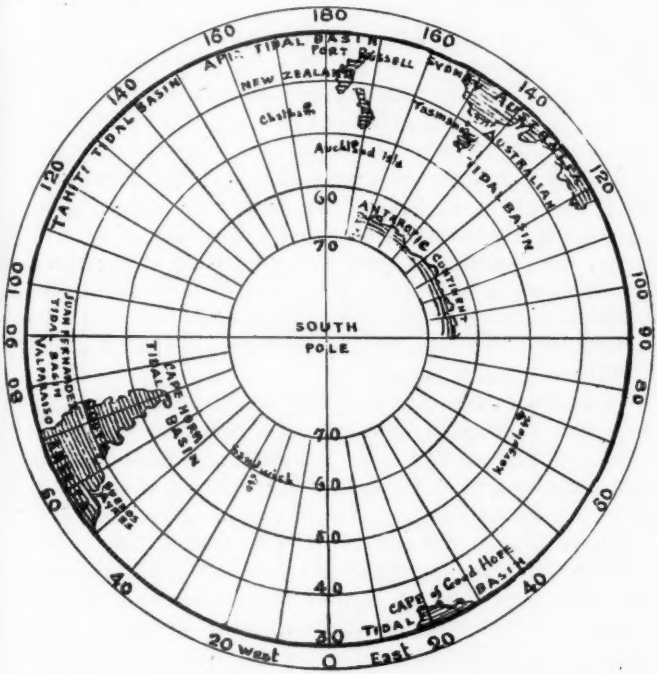
But let us try another test of the principle of geographical boundaries and their effect upon time-intervals. We take the case of the South Pacific. That ocean has no land barrier on the south shutting it out from communication with the Antarctic, and at Apia, Port Russell, New Zealand, and Valparaiso the time-intervals



SKETCH MAP SHOWING CLOSED COMMUNICATION BETWEEN ARCTIC OCEAN AND NORTH PACIFIC OCEAN; RESULTING IN IRREGULAR TIME-INTERVALS FROM ONE HIGH WATER TO THE NEXT.

at all of these stations—one in the midst and one on either shore, east and west—are very regular; making a complete contrast with the irregularity of the North Pacific. The communication is wide open between the South Pacific and the Antarctic; and it in turn is open on the east and on the west. Hence the South Pacific is open at both ends, and it forms part of a system of basins with regular time-intervals; in which system the oscillating potential force is generated within each basin when standing at highest level. The

weight and pressure from one basin is counterbalanced by the weight and pressure of another, but the movement from one to another is immediately due to the opposition of contiguous regions of high and low level. This system of double-pressure basins is linked one with another even as the links of a chain, and that chain encircles the globe in the Southern Hemisphere; but a branch extends through the Atlantic into the Arctic Ocean, and everywhere —in each link—a remarkable *family* resemblance is observed in the time-intervals.



SKETCH MAP SHOWING OPEN COMMUNICATION ALL AROUND THE SOUTHERN HEMISPHERE; RESULTING IN A CHAIN OF DOUBLE-PRESSURE BASINS ENCIRCLING THE GLOBE.

But it is not so with the North Pacific. The family likeness is lost there because the linking is imperfect, for it is linked upon *one* end only; therefore it is a lopsided link, only a pendant to the chain, and produces another variety, or type, of tide—as different from the type of tide at Apia as the Japanese type of face of its kind is different from that of the English-speaking race.

7. Tidal Basins in the Pacific Ocean.

It is too early in the history of the new science of the tides to set forth the number of tidal basins in the Pacific or to describe their boundaries. All that we can do at present is to announce the fact that they do exist and to give the proof of their existence.

For example, when the tide is high at Apia it is low at Tahiti, and *vice versa*.

Apia is situated in west longitude 171° 44′
Tahiti " " " " " 149° 30′

Tahiti has high water 6 hours 53 minutes local time before Apia; the two stations are separated by 22° 14′ in longitude. That calls for a difference in moon-time of 1 hour 29 minutes; but the difference in their times of high water is very much greater. Now, if the moon can lift the tide, instead of a much greater difference in their times of high water the interval ought to be 1½ hours exactly.

Here, then, is an example of two large contiguous regions in mid-ocean where tide verges towards the condition of high in the one when the condition is quite different in the other; therefore the two places are in separate tidal basins. The case being so, there can be no interference from *friction* by submarine land barriers, because the water is very deep between the island groups to which the two stations belong.

With regard to the extent of Apia basin, we find that Apia is co-tidal with Vavou, and Tongatabu, Friendly Islands; and about co-tidal with Totoya, Vita Levu, Kandara, Fiji Islands; Penrhyn Island; Raratonga, Cook Islands; with the detached islands Rotumah and North Minerva Reef; the basin extends to New Zealand and Norfolk Island; and towards New Caledonia, New Hebrides, and New Britain. But in the latter region a total dislocation occurs, for when it is high water at Blanche Bay, New Britain, it is low at Holtz Haven, New Ireland; yet the two stations are only 1° 15′ apart in longitude. Then, again, a difference of 3½ hours occurs between the time of high water at Tubuai, Austral Islands, and Tahiti; indicating thereby that Tubuai is on the boundary line of Tahiti basin. The two stations are situated in the same meridian, the one almost exactly six degrees due south of the other; yet there is a difference of 3½ hours between their times of high water. Now that fact is contrary to lunar theory; nay, more, it is absolutely destructive of that theory, and the case occurs right in the midst of the ocean, where lunar tides are supposed to have freer sway than anywhere else on the face of the globe.

NOTE.—When all the evidence is in, possibly it may be found that Juan Fernandez basin is only the eastern end of Tahiti basin.
= Boundaries of Basins—regions of half tide between regions of ebb and flood.

With regard to Tahiti basin, it extends easterly 40° to Easter Island, but immediately beyond it the time of tide changes suddenly. Sala y Gomez Island is only about 4° beyond Easter Island, but the difference in their times of high water is 3¼ hours—an enormous difference when compared with the difference in moon-time, for it is only 15 minutes. This case and the case of Tubuai and Tahiti clearly prove that moon time and time of tide have no connection with each other; that the two things are absolutely apart and irreconcilable. Then, again, when Tahiti has high water it is only half tide at Marquesas Islands; the difference in moon-time is only about 40 minutes, but their difference in time of tide is about 3 hours.

The detached Oparo Island is about co-tidal with Tahiti. The line of cleavage dividing the basins of Tahiti and Apia seems to run northwesterly from Tubuai towards Penrhyn. These two great basins stretch almost the entire distance across the South Pacific, and they form the southern boundary of the North Pacific basin. But when they attain high-water level they do not deliver their pressure at the same time—the Apia delivers at one time and the Tahiti at quite another. Consequently that fact, taken in conjunction with the other fact of the isolation of the North Pacific, gives us the reason why its time-intervals are so very irregular; that irregularity is due to the lop-sided mechanical action as well as to its geographical isolation.

With regard to the extent of the North Pacific basin, Honolulu, Christmas Island, and Midway Island are about co-tidal; the last two are separated by about 26° in latitude; the basin extends to the Marshall and Gilbert Islands, but the Ladrone and Bonin Islands seem to lie beyond its western boundary. In the northern boundary St. Paul, Alaska, is not co-tidal with Honolulu; although the difference in time between these two is only 22 minutes, the difference in time of tide is about 3 to 4 hours, thus giving another proof of the irreconcilability of nature and the theory.

Nor is Honolulu co-tidal with San Diego, California. For example:

On Jan. 1, 1900, high water was at San Diego 8.35 A.M., 10.01 P.M.,
" " " " " Honolulu 3.50 " 3.50 "

The two places are separated by 40° 16′ in longitude, and if the moon can lift tide the difference in their time of high water ought to be about 2¾ hours instead of 7¼ and 6¼ for the two tides respectively. In fact, these figures clearly show that San Diego forms a tidal basin by itself. Crossing over from San Diego to the Bonin Islands, south of Japan, we find another case of almost

total dislocation; we find that Newport, Hillsboro Island, has high water 5 hours 20 minutes after Port Lloyd, Peel Island; yet they have the same local time! Still further evidence of separate smaller tidal basins is indicated in the seas of China and Japan—not to speak of Okhotsk and Bering Seas, and also in the extreme south, for the difference in the time of high water between Port Russell and Auckland Isles is 3 hours 54 minutes: Port Russell, New Zealand, is 35° 16′ S. L., and Port Ross, Auckland Isles, is 50° 32′ S. L. Port Russell lies in Apia tidal basin, but Port Ross lies on the boundary of that basin. There is also a difference of 3 hours 08 minutes between Port Russell and Port Hutt, Chatham Islands. Port Hutt lies 9° 18′ east of Port Russell, and if the moon can lift tide the difference in time of high water ought to be 37 minutes instead of more than 3 hours! The southern boundary of Apia basin seems to run northeasterly from Port Ross to Port Hutt.

Tidal dislocation is also complete between Melbourne, Victoria, Australia, and Hobart, Tasmania. Another case where nature and theory fail to agree.

Finally, we will examine what evidence there is upon the eastern shore of the Pacific. In that long and almost straight line of coast there are indications of more than one tidal basin.

When high water occurs at Cape Horn, low water occurs at Corral, Port Valdivia: the difference of 6° in longitude between the two stations calls for a difference in time of high water of about 25 minutes, but the difference is 6 hours 19 minutes! What a marvellous moon to work such contradiction against itself—*i. e.*, against its own *imputed* power—and imputed, too, by all the high authorities in Christendom!

We call these two South American basins, just indicated, Cape Horn tidal basin, and Juan Fernandez tidal basin respectively; high water takes place at the island of Juan Fernandez 5 hours 14 minutes after Cape Horn. Juan Fernandez basin makes the third tidal basin stretching across the entire width of the South Pacific, from New Britain to Chili. But, possibly, when all the evidence in the case is in, it may turn out that Juan Fernandez basin is the eastern end of Tahiti basin.

Proceeding still farther north we find another total dislocation at Eten Point, Peru, and we call the region Panama tidal basin. This basin is co-tidal from about Santa Elena Bay, Ecuador, to Panama (Naos Island), and thence to Port Elena, Costa Rica, and includes Galapagos Islands. Proceeding still further north, we

return to San Diego tidal basin, and we find that the south boundary of this basin reaches to the west coast of Mexico, whilst San Diego itself is co-tidal with Mazatlan, Mexico, and Lompoc Landing, California. And now we pause to look at the freakishness of the North Pacific variety. For instance:

Jan. 1, 1900, San Diego had high water at 8.35 A.M. and 10.01 P.M.
" " " San Francisco " " "12.06 " . " 10.23 A.M.

San Francisco is west of San Diego 5° 15′, calling for a difference in time of 21 minutes, but the difference in the early morning tides is 8 hours 29 minutes. Then, again, at San Francisco, from first high water to first low water, on the first day, the time-interval is 4 hours 25 minutes, and from first high water to second high water 10 hours 17 minutes, and from second high water to first high water 14 hours 22 minutes on the second day. Quite a jumble of freaks within so few hours. We also observe that the moon was new on the first day of January, 1900, and the first high water occurred at midnight. That is correct according to the rules of the science. But we also observe that the second high water took place 1 hour 37 minutes ahead of mid-day. That is not correct according to the rules. With regard to this thing, we think that it would not astonish a railway passenger when taking, say, a 6 hours' journey to arrive at his destination 1½ hours *behind* schedule time; but it would be a wonderful thing, indeed, if he should arrive 1½ hours *before* schedule time.

In conclusion. It is an indisputable fact that some changes in the level of the sea are due to causes other than to the opposition of contiguous regions of high and low water level. For instance, meteorological conditions cause changes through atmospheric pressure, and wind pressure, evaporation, etc. Wind pressure and atmospheric pressure cause greater or lesser disturbances very frequently in sea-level, but *not* at regular times, except in the regions of trade winds. And even they could not get up a speed of 17 miles a minute! Evaporation, melted snow and ice, and large rivers discharging volumes of fresh water into the ocean cause changes in the local density of sea water. But none of these active agents can produce the *rhythmic* movements of our daily tides! (or produce the family resemblance in all double-pressure basins.) During the cruise of the *Challenger* 650 observations were taken of the wind, and it was found that on the open sea the average speed was 17½ miles an hour, and near the land the average was 12½ miles an hour. But we have not found that they discovered a speed of 1,040 miles, or even of 500 miles an hour in the water of the sea! How-

ever much the whole world of science is indebted to the truly noble *Challenger* Expedition, the fact that it failed absolutely to find sea water moving at the rate of 8 to 17 miles a minute, in the same sea where we are told that tides have almost uninterrupted sway, is, to say the least, a heavy loss to lunar science. It is to be remembered that the science of mathematics "treats of exact relations existing between quantities or magnitudes, and of the methods by which, in accordance with these relations, quantities sought are deducible from other quantities known." The early fathers of the science had no knowledge of the tides of the world, and the modern masters know so little that the author of *The Tides* humbly confessed and said:

> I do not reproduce the chart of the Pacific Ocean, because it is almost blank from deficiency of data. . . . Thus, in that part of the world where tides are most normal we are compelled to admit an almost total ignorance. (Pages 188, 189.)

It is true that tidal data are still very limited; nevertheless, we hope that this work is only the beginning of a movement which, when once established, will not stop until a radical revision is made of the whole subject. And that work belongs to the Geographical Societies, for it would be quite as reasonable to ask mathematicians to solve the problem of ocean depths still unknown by means of mathematics only as to permit them to remain the tide masters of the world. Tides, like unknown regions—the North Pole, for instance—must be seen by the *eye* if we would understand either aright.

THE ISTHMIAN CANAL.

BY

ARTHUR P. DAVIS.

The unanimous judgment of the Isthmian Canal Commission, and the common consent of the general public, have very properly narrowed the discussion of the Isthmian Canal question down to a comparison of the relative merits of the two routes familiar as the Nicaragua and the Panama.

The thorough investigations and estimates of cost made by the Commission, and the recent offer of the Panama Canal Company to transfer their property to the United States for forty millions of dollars, make the total cost of the Nicaragua about $190,000,000, and of the Panama $184,000,000, not including the concessions which are yet to be obtained from the respective Governments. The work at Panama is so concentrated at the Bohio dam and the Culebra cut that its construction will require longer than the other route, and this will probably compensate for the difference in cost.

It may be assumed for the purposes of this comparison that the Panama Company can convey a perfect title, and that equally favourable concessions can be obtained from both Republics.

Many extravagant claims are made by the partisans of both routes, but their real important advantages may be summed up as follows:

Advantages of Panama:

1. It is shorter, being 49 miles as against 184, and would for this and other reasons be cheaper to maintain and operate, and require less time for passage.

2. It has fewer curves, and they are of longer radius.

3. It has fewer locks.

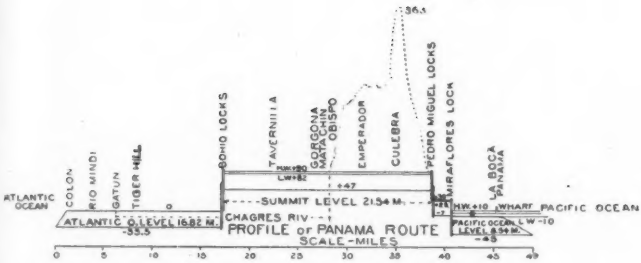
4. It is shorter by several hundred miles from ports of western South America to all other points, the voyage to which would include the Isthmian Canal.

The advantages of the Nicaragua route are as follows:

1. It is several hundred miles shorter than the Panama route, on all voyages of which both termini are in the Northern Hemisphere—for instance, from San Francisco to New Orleans, New York or Liverpool, and from North American to Asiatic ports.

2. The constant trade winds afford better facilities for the approach and departure of sailing vessels than Panama can offer.

XUM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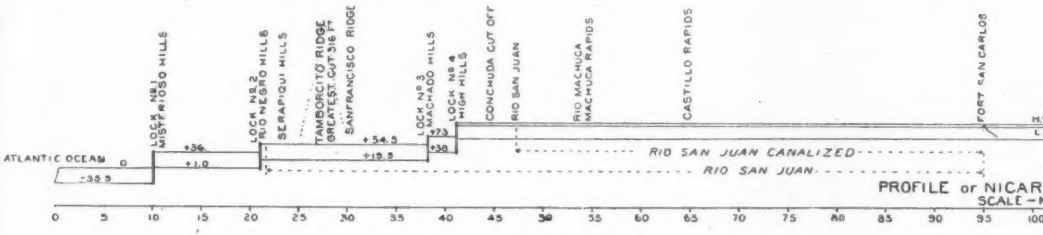
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MISTY RIDGE
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RIO NEGRO HILLS
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LOCK NO 3
MACHADO HILLS
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RIO SAN JUAN
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CASTILLO RAPIDS
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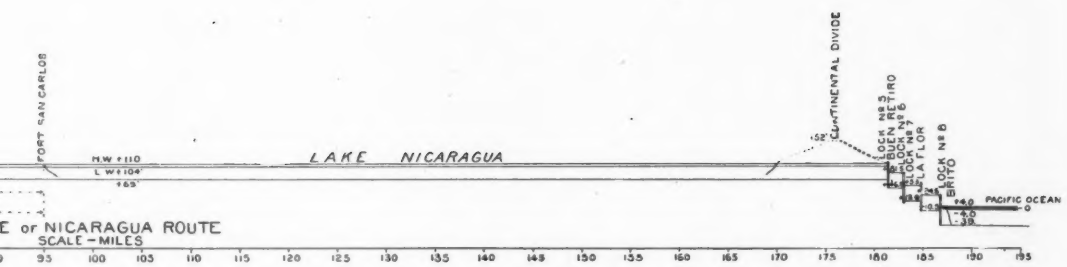
FORT SAN CARLOS
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LAKE NICARAGUA
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CONTINENTAL DIVIDE
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BUEN RETIRO
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LA FLOR
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BRITO
PACIFIC OCEAN
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E or NICARAGUA ROUTE
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XUM

3. The canal route passes through an unsettled region of large extent and immense natural resources, which would be developed by the canal. This region will open up a large trade with American ports, and contribute a considerable revenue to the canal.

4. It is a healthier climate than Panama; though the reasons are not entirely clear, the fact is undeniable.

The above are the main real physical advantages that can be established by the respective routes; others claimed being mostly imaginary or relatively unimportant.

The advantages of Panama, and the first two assigned to Nicaragua, are purely material and reducible to a basis of dollars and cents, though the best judgments will differ as to actual figures. Nicaragua's advantages in health and development are of a totally different class, being much more difficult to estimate and to reduce to monetary expression. The first class of features will be first considered.

Where possible, in large engineering works, the usual and proper method of making estimates is by comparison with previous experience, allowing, as far as possible, for known differences of condition and circumstances. The probable cost of maintenance and operation of an American canal can best be estimated by this cost upon the great ship canals of the world, having due regard to difference of conditions.

The following table gives the traffic and cost of maintenance and operation of the four principal ship canals of the world, as taken from their official reports:

TRAFFIC AND COST OF OPERATION OF SHIP CANALS.

CANAL.	YEAR.	TRAFFIC IN TONS.	ANNUAL COST.
Manchester	1898	2,595,585	$861,976
(35.5 miles.)	1899	2,778,108	927,140
	1900	3,060,516	1,004,333
Suez	1898	9,238,603	1,592,834
(88 miles.)	1899	9,895,630	1,661,042
	1900	9,738,152	1,742,717
Kiel	1898	3,117,840	492,080
(61.6 miles.)	1899	3,488,767	540,128
Sault Ste. Marie	1897	17,619,933	78,104
(1.6 miles.)	1898	18,622,754	58,890
	1899	21,958,347	90,307
	1900	22,315,834	79,293

The chief elements of cost in maintaining and operating a great canal depend upon its length, number of locks, amount of traffic,

and the amount and radius of its curvature. These may be compared in the following table:

COMPARISON OF SHIP CANALS.

	SAULT STE. MARIE.	SUEZ.	MANCHESTER.	KIEL.	PANAMA.	NICARAGUA.
Length in miles.....	1.6	88	35.05	61.6	49	184
In natural lakes.....	0	8	0	4	0	42
Bottom width in feet..	108	122	120	72	150	150
Depth in feet	21	28	26	29.5	35	35
Number of locks.....	1	0	5	2	5	9
Maximum lift in feet..	18	0	16.5	16	43	37
Total lift in feet.....	18	0	0	16	86	107
Radius, sharpest curve.	Infinite.	5900	1980	3280	6234	4045
Miles of curvature....	0	31	15.6	23	20	50
Degrees of curvature..	0	0	0	0	772	2340
Deepest cut in feet....	30	85	66	100	312	300
Cost—million dollars..	7.85	115	76	37	184	190
Traffic began.....	1855	1870	1894	1895	—	—

The most striking of the above facts is the great cost of operating the Manchester, considering its length and its traffic. This is accounted for by its large proportion of locks and its short radii of curvature. The latter feature is very important. When a large vessel is in a canal and draws nearly as much water as the available depth she will not obey her helm, and it becomes impossible to steer her safely around short curves, and a strong stern or beam wind aggravates the difficulty. For this reason every large vessel that passes through the Manchester Canal is attended by two tugs, one at bow and one astern, to conduct her along the tortuous channel. The Suez Canal was first built with curves of 2,300 feet radius; but these caused so much annoyance that a large part of the canal was reconstructed, and now the shortest radius is 5,900 feet, about three times that of Manchester. The great cost of maintenance and operation of the Manchester, and the low cost of that on the Kiel, together with the complication of length, locks, and curvature on both, make it difficult to use their data in estimating the relative influence of each feature on the total annual cost. In the Sault, however, we have a canal without curvature, only 1.6 miles long, and one lock. Its cost is, therefore, chiefly the maintenance and operation of that lock—about $60,000 per annum—and is thus of value for comparison with the Isthmian Canal locks. Though it handles a very much heavier traffic than the Isthmian canal will ever have, the latter will have to contend with a wet tropical climate, and is remote from commercial centres,

and these will tend to increase its cost. We may, then, without important error, take $60,000 per annum as the cost of maintaining and operating each lock on the Isthmus.

The Suez Canal has no locks, and very gentle curvature, and a traffic similar in character and magnitude to that expected for an Isthmian canal. It is, therefore, of value in estimating the annual cost due to length only. It is greatly annoyed by drifting sands, which increase its cost; but, on the other hand, the Panama Canal receives the waters of the Upper Chagres into Lake Bohio, which, though not a muddy stream, may in the future require some attention; while the Nicaragua route receives the waters of a large number of small tributaries, and Greytown harbour will require constant dredging to counteract the tendency to close up, under the littoral action on the sands; but these difficulties are not nearly so important as the drifting sands at Suez, and a much smaller figure should be taken for the American canals. From the above table we find the cost on Suez to average about $19,000 per mile. Adopting $15,000 for the mileage cost of the American canals, and $60,000 each for the locks, we have figures which should approximately satisfy the conditions on the Isthmian canals. They give results somewhat too small when applied to Manchester, but larger than those reported for the Kiel.*

In applying these estimates to the American canals, we will omit the deep water of Lake Nicaragua from the length of that canal, and we then obtain the following results:

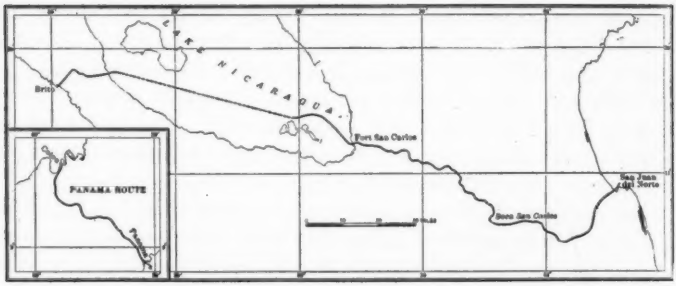
For Nicaragua:	
Length, 142 miles at $15,000 per mile,	$2,130,000
8 locks at $60,000	480,000
Total annual cost	2,610,000
For Panama:	
Length, 49 miles, at $15,000 per mile,	735,000
5 locks at $60,000	300,000
Total annual cost	1,035,000

Assuming a traffic of 8,000,000 tons per annum, this would be nearly 33 cents per ton for Nicaragua, and 13 cents for Panama, without including any allowance for Panama's advantage in curva-

* The low cost reported for the Kiel canal is supposed to be due in part to that portion of its work performed by the Army and Navy, being charged to the military establishment instead of the canal.

ture, which the above table shows is considerable, nor for the fact that Panama will control her flood waters automatically, while Nicaragua will not.

It now remains to compare, in view of the above, their respective advantages in distance. A vessel cannot, with a given power, move so rapidly through a canal as through deep water, and if she could it would not be safe to do so. It may be assumed that, on an average, vessels will move through the canal at half the speed they would accomplish at sea. To allow for this we will, in comparing distances through the canals, add 40 nautical miles to those *via* Panama and 120 to those *via* Nicaragua, and this will compensate for their difference in length, since this is about the length in nautical miles in each case, which is equivalent to the assumed delay by the canal proper. By comparison of distances computed



on this basis we can determine their relative advantages to commerce.

It is estimated by good authorities that the average cost for carrying freight over long ocean voyages is one mill per ton-mile, of which one-half is for shore expenses, loading and unloading, warehouse, insurance, etc., leaving one-half mill per ton-mile for moving freight through the water.

There are eight typical routes of travel that would use an Isthmian canal. The following table shows the relative distances saved for these eight classes of traffic, allowing for delay in transit, due to canal length, as above indicated. The last column shows the amount per ton that vessels would save by going *via* Panama, on the assumption that both canals are to open traffic, and the tolls fixed to just cover cost of maintenance and operation, computed as above:

COMPARISON OF DISTANCES SAVED BY NICARAGUA AND PANAMA CANALS.

		VIA NICARAGUA.	VIA PANAMA.	SAVING VIA NICARAGUA.		NET ADVANTAGE OF PANAMA.
FROM	TO	MILES.	MILES.	MILES.	PER TON.	PER TON.
San Francisco	New York....	5,040	5,340	300	$0.15	$0.05
	Liverpool	7,770	8,080	310	0.16	0.04
	New Orleans..	4,240	4,740	500	0.25	−0.05
Yokohama	New York....	10,870	11,050	180	0.09	0.11
	New Orleans..	10,070	10,450	380	0.19	0.01
Guayaquil, Ecuador,				SAVING VIA PANAMA.		
	New York....	3,370	2,910	460	0.23	0.43
	Liverpool	6,100	5,650	450	0.22	0.42
	New Orleans..	2,560	2,300	260	0.13	0.33

From the above we observe that, on the assumed value of distance saved with the tolls adjusted to expenses, all steam traffic on seven of the typical routes would prefer the Panama Canal, the advantage of this route ranging from 1 to 43 cents per ton, while on the eighth type of voyage the advantage is with Nicaragua.

The above estimates apply only to traffic carried on in steam vessels. The Bay of Panama is so subject to protracted calms that it is not likely that sailing vessels will extensively use a canal at Panama; while the almost constant trade winds at Nicaragua will afford all desirable facility for approaching and leaving the canal and for passing through from east to west. It will not be easy, however, for sailing vessels to beat against the wind in a narrow, crooked channel, and east-bound sailing vessels will probably have to be towed through, which will be expensive. The advantage, however, is largely with Nicaragua as regards sailing vessels, which perform about 10 per cent. of the ocean freighting, while of the American Merchant Marine more than one-fourth is sail. These facts, taken with the showing above, indicate that perhaps one-third of the traffic would seek the Nicaragua route and two-thirds the Panama, if both were operated at cost. It is not surprising, therefore, that the latter was recommended by the Isthmian Canal Commission.

There are, however, two advantages possessed by Nicaragua, which should not be forgotten, and which largely offset the great advantage in annual cost which Panama will enjoy.

The Panama Canal crosses a narrow, mountainous isthmus, with little possibility of development, and with a very unhealthy climate.

On the other hand, the Nicaragua Canal will for most of its length pass through the heart of a vast tract of tropical forest, now a wilderness, with immense agricultural, horticultural, and mineral resources, capable of employing and supporting millions of people. A good harbour, interior transportation, and a stable government, which are now lacking, will be furnished by the construction of the canal. This great work will induce such an influx of American capital and immigration that they will soon dominate the country, and it will surely, like Hawaii, become American of its own motion. Its production of wealth will be enormous; the canal will furnish a fine outlet to all the world, with the aid, as feeders, of lakes Nicaragua and Managua, San Carlos, and Sarapiqui rivers, and numerous small streams.

The health of this region is remarkably good for a tropical country, yellow fever being unknown, though common both to the north and south; and other tropical ailments being less prevalent than elsewhere. The heat is not excessive, being greatly tempered by the fresh trade winds that prevail. If there is anywhere a tropical country susceptible of profitable Caucasian colonization it is the Nicaragua canal region.

ABSTRACT OF AN ADDRESS BY M. HUGUES LE ROUX,

MARCH 18, 1902.

"UNE VISITE À L'EMPEREUR MÉNÉLIK."

M. Hugues Le Roux was invited by the Emperor Menelik to visit Abyssinia. Menelik believed that Europeans were insufficiently informed as to the agricultural and mining resources of his country, and, in particular, regarding the organization of a kingdom which is not the modern creation of a superior mind, but one of the most ancient civilizations of the world. At a time when Abyssinia was about to be connected with the Red Sea by a railway, he wished it to be known in Europe through what historical and economical conditions his kingdom had passed and to what stage of evolution it had come.

M. Le Roux set out for Abyssinia under these circumstances in the month of November, 1900. The Emperor had sent an escort of Abyssinian soldiers to meet him at the coast. M. Le Roux traversed with them the country of the Issas, who occupy all the region which lies between the Abyssinian mountains in the west and the Red Sea in the east. They are a savage population who, for centuries, have massacred all the expeditions sent to Abyssinia and have been the cause of the isolation into which that country has fallen.

M. Le Roux proceeded to Abyssinia by the road of Harar, the town conquered from the Mussulmans by the Emperor Menelik. It is one of the greatest centres of African commerce—coffee and cotton. The United States sell in this market $5,000,000 worth of cotton goods a year.

Leaving Harar behind him, M. Le Roux traversed the wild woodlands which lead to Addis Abeba. Menelik has connected Addis Abeba with Harar by means of a telephone. It runs across these forests, and is often broken by elephants and monkeys, and the other wild animals which make the Abyssinian woods the hunter's paradise.

In Addis Abeba M. Hugues Le Roux was the Emperor's guest. He remained in the town as long as was necessary to become acquainted with the manners and customs and social institutions, and then accepted from the Emperor the command of a troop of soldiers, with a mission to go to the west and draw the map of the

unknown region where the Blue Nile runs in a southerly direction before it turns, almost at a right angle, and makes its way towards the north. No one had ever before penetrated into this swampy region abandoned to the Beni-changoul, or Shangallas. Menelik did not want to send a warlike expedition against them, out of a fear of seeing laid waste once more the whole of this western tract. He thought that an expedition of an almost scientific character, backed up with a few guns, would have some chances of success where a great many guns alone might fail.

M. Le Roux succeeded in reaching the Blue Nile. He descended with his horses and mules from the heights of Mount Tchoki to the swamp, and marked the place where the Blue Nile, flowing towards the south in the direction of Lake Rudolf, finds the way barred by a great mountain mass, and is thrown back northwards. The Beni-changoul endeavored to prevent his return, but he was able to pass through their resistance without serious loss, and took back to Menelik the map which definitely fixes the course of the Nile. The Emperor, to recompense him, gave the name Hugues Le Roux to the mountain which stops the river in its southward flow.

M. Le Roux, in the course of his lecture, gave very interesting information concerning the Byzantine origin of Abyssinian civilization. He told the story of the conversion of the Abyssinians to Christianity in the third century. He showed how they were governed by the laws of the Emperor Justinian, and how they were ripe in every way for the modern culture which the railway will carry to them. He asserted, moreover, that the Cape to Cairo railroad could not be built without the co-öperation of the Abyssinians, who were willing, indeed, to be associated with every peaceful undertaking, but who disposed of 500,000 modern rapid-firing guns for the prevention of any undertaking which was not commercial in its character but aimed at the enslaving of Christian populations who cherish their liberty.

NOTES ON CLIMATOLOGY.

BY

ROBERT DEC. WARD.

THE DUSTFALL OF MARCH 9–12, 1901.—There are several instances on record of the occurrence of falls of dust in different parts of Europe, the origin of the dust having been in the desert region of northern Africa, and the fall having taken place either with or without precipitation. The remarkable dustfall of March 9–12, last year, fortunately took place over some of the most thickly-settled portions of Europe, where there are numerous meteorological stations, and where, in consequence, all the phenomena associated with the occurrence were carefully observed. A monograph on this duststorm has recently been published by Hellmann and Meinardus, of the Prussian Meteorological Institute in Berlin, and this is the most elaborate report upon any such storm that has ever been issued (*Der Grosse Staubfall vom 9 bis 12 März, 1901, in Nordafrika, Süd- und Mitteleuropa*, Abhandl. K. Preuss. Met. Inst., II, 1).

The district over which the dust fell extended from the desert of southern Algeria northward into southern Denmark, *i. e.*, over a distance of more than 25° of latitude, and the total area of the region was at least 800,000 sq. km. An additional 450,000 sq. km. were taken up by water surfaces. Duststorms occurred in southern Algeria on March 8–10; and as the dust was carried northward it fell in Sicily and in Italy on March 10; in the eastern Alps on the night of the 10–11th; in northern central Germany on the forenoon of the 11th; in northwestern Germany on the afternoon and evening of the 11th; and in southern Denmark on the night of the 11–12th. Further eastward the fall came later. Thus it occurred in Hungary on the morning of the 11th; in Galicia, Posen, and western Prussia on the afternoon, and in eastern Prussia late in the evening of the 11th; and in the Russian provinces of Kostroma and Perm on the afternoon and evening of the 12th. In Algeria and in Tunis the fall was of dust. In Italy dust fell during a dry *sirocco* wind, and rain heavily charged with dust also fell. In Austria-Hungary and further north the phenomenon was everywhere associated with some form of precipitation (rain, snow, frozen rain, etc.). The amount of dust decreased from south to north, which is one proof of the southern origin of the dust. Two-

thirds of the total fall occurred south of the Alps. The color of the dust was reddish-yellowish-brown, and microscopical examinations of the deposit collected in various places made it plain that the dust was of terrestrial origin—an æolian deposit resulting from the disintegration of rocks in a desert region. As the distance from their source increased, the dust particles became finer and finer, and a decrease in the percentage of quartz was noted. As the dustfall progressed northward a barometric depression advanced from Tunis in a north-northeast direction to the southern shore of the Baltic Sea. The exact place of origin of this depression cannot be determined, but the winds and weather on March 9 seem to show that a depression was at that time located in the desert region of southern Algeria; and this depression was probably strengthened on its northward progression by combining with a second weak area of low barometer which came from northwestern Europe. The pressures at 2,500 metres above sea-level show that as the dustfall moved northward there was a southerly upper current at that altitude from Tunis to central Germany. The velocity of this upper current was found to be 70 km. an hour, and the northward progression of the dustfall was also found to be at the same rate.

Altogether, the report made on this interesting phenomenon by Drs. Hellmann and Meinardus is most complete and most suggestive. There is much in the volume which will interest the geologist and the geographer, as well as the meteorologist. It is fortunate that this remarkable dustfall came where it could be so well studied, and that two such competent meteorologists set themselves the task of discussing the data.

THE HEALTH OF THE ARMY IN 1901.—Climatologists, as well as medical men, may find much of interest—and it may also be much of discouragement—in the annual *Report of the Surgeon-General of the Army* for the year ending June 30, 1901. There is abundant evidence in this report that the United States is involved in tropical warfare, with all that that means in the way of disease and death among those whom duty calls to service in climates other than their own. There are, of course, also many most encouraging signs of success in the treatment of various diseases. Thus the United States General Hospital for the treatment of pulmonary tuberculosis at Fort Bayard, New Mexico, has proved extremely useful. The selection of this site for such a hospital has been amply justified by the results. The location is in the dry mountainous region of New Mexico, at an altitude of 6,040 feet above sea-level, and the climate permits comfortable outdoor life during the entire year. The

mean maximum temperature for the past ten years was 69.6°, and the mean minimum 39.8°. In 78 per cent. of the cases treated during the year the disease was contracted in the Tropics. In the report of the United States General Hospital, Presidio of San Francisco, there is some information regarding the cases of insanity among soldiers who have seen service in the Philippines, which is of interest because of the considerable prominence that has lately been given this subject in the daily press. The surgeon in charge of the Presidio Hospital says that the etiology of insanity in soldiers who have returned from the Philippines is at once a simple and a complex subject. A large proportion of the cases which become insane he believes to have had a hereditary taint, which was not discovered prior to enlistment.

> This, taken with the long distance from home, the intense heat of the tropical sun, constant harassment by an enemy which it is impossible to see, excessive use of alcoholics, and the depressing influences always present in a tropical climate, will account for the changed mental condition.

The death-rate from disease in the Philippine Islands was 20.26 per thousand, the principal cause of the fatalities being dysentery. In connection with this seemingly low death-rate it is well to point out that a large number of soldiers are invalided home who would undoubtedly die were they to remain in the tropical climate, and, further, that the death-rate of most of our cities, which does not differ very much from the figures above given (20.26 per thousand), includes persons of all ages and of both sexes, and includes deaths of all kinds. In the case of the death-rate of the army in the Philippines men only are concerned, and these are supposed to be picked men, of sound health, most of them still to be called young, in the prime of life. In the City of Boston the death-rate for five recent years was 21.28 per thousand, but the average death-rate for males between 20 and 50 years of age was but 3.42 per thousand. It is with this death-rate of 3.42 per thousand (in the case of Boston) that the death-rate in the Philippines should be compared. The death-rate among the British troops in India in 1896 (the last year for which the compiler of these NOTES has the data) was 14.84 per 1,000 of strength. In China the date-rate of our soldiers from disease was 23.62 per 1,000.

Col. Charles R. Greenleaf, Chief Surgeon, Division of the Philippines, reports that

> The most energetic and stalwart American after a year of service here loses energy, strength, and ambition. He performs what work his duty demands more or less half-heartedly, and with a draft on his vital energy that he can actually feel at the time.

Regarding the campaign in China, Surgeon G. A. Lung reports that the excessive heat experienced sometimes resulted in the prostration of 150 men, many of these having convulsions. Some of those who had convulsions, and were rendered unconscious, could walk into camp in the cool of the evening. An interesting note regarding the climate of Peking is worth mentioning here. That section is frequently visited during the winter by severe winds of several days' duration. Duststorms of indescribable severity are thus developed, and these cause great bodily discomfort and annoyance, as well as constituting one of the most unhealthy conditions of Peking. In every case, after a severe storm of this character occurred, the sick report was materially extended, the additional causes of admissions being affections of the respiratory organs, including pneumonia and bronchitis. A sanitary commission, consisting of the foreign medical officers in Peking, inaugurated a system of street sprinkling, to the great benefit of all the foreign residents.

During the year 1897, when all the troops of the United States served at home stations, the hospital admission rate for diarrhœal diseases was 73.77 per 1,000 of strength, with no deaths. Dysentery was a comparatively rare disease, and seldom fatal. In 1898, as a result of war service in Cuba, Porto Rico, and the Philippines, the admission rate rose to 388.62, and the increased gravity of the cases was shown by a death-rate of 1.45 per 1,000 of strength. In 1899 the admission rate was 380.69, and the death rate 2.14. During 1900–1901 the admission rate increased to 465.01 and the death-rate to 6.47, because of the relatively large proportion of the army which was exposed to the causes of diarrhœal and dysenteric diseases in the Philippines. Among troops serving in the United States the admission rate last year was only 96.57.

The problem of the acclimatization of the white race in the Tropics, as already stated several times in these NOTES, has hitherto been discussed solely by European writers, chiefly French and German, because European nations have had experience in the settlement of tropical possessions, whereas we of the United States have, until 1898, had nothing to take us to the Tropics as a people. Now, however, with our occupation, temporary or permanent, of tropical islands, we North Americans are gathering material from our own experience which will make it possible for us to discuss this question on our own account. The report of the Surgeon-General of the Army, now under consideration, contains some American contributions to the acclimatization question. In addition to the facts above referred to, regarding tropical diseases and the death-

rate from disease, we find some more direct statements in the *Observations upon Diseases in the Tropics*, by Major Charles P. Mason, Surgeon 26th U. S. Infantry, at Jaro, Province of Iloilo, Philippine Islands. Very striking is Major Mason's statement:

> In the first place, as to acclimatization, if that term is intended to convey the idea that the constitutions of white men gradually adjust themselves to tropical conditions, and thereby become better able to withstand disease, then I do not believe that there is any such thing as acclimatization. Men do gradually learn how to take better care of themselves, and to that extent are less liable to disease; but, in my opinion, the great majority of white men in the Tropics suffer a gradual deterioration of health, and year by year become less and less fit for active service.

While this may seem to some a rather exaggerated statement, it is, nevertheless, important as coming from a competent observer, who has had excellent opportunities to study the effect of a life in the Tropics upon the American soldier. Major Mason's other observations upon tropical diseases are likewise noteworthy. Dysentery he finds prevailing throughout the year, with a marked increase in the number and severity of the cases at the commencement of the rainy season, and a progressive increase in both respects until a maximum is reached toward the end of August. This is the most serious disease, both as regards its mortality and its invaliding effects. While dysentery is most prevalent during the rains, smallpox is found most common during the dry season, disappearing almost completely in the rainy season. This may possibly be explained by the greater freedom of communication during the dry season, when travelling is easier, or, more probably, by the agency of dust as a carrier of infection.

NOTE ON THE TIDAL BORE.

BROOKLYN, March 25th, 1902.

EDITOR BULLETIN:

Will you allow me a few words in relation to the following quotation, taken from *The Solution of the Problem of the Tidal Bore*, published recently in No. 4, page 319:

> Whence does this energy come [the energy of the bore]? Now, I say that it comes from the rotation of the earth.
>
> THE TIDES.
>
> His [Mr. Darwin's] third attempt to solve the problem comes to us as a great surprise; and, strangely enough, it stands without the support of a single reason, or of an observed fact, to prove it in *The Tides;* therefore, it is merely a personal opinion, and nothing more.

I wish to state that those familiar with the results obtained in the use of large centrifugal machines will not agree with this conclusion. If permitted, I should like to detail experiments that, I think, tend to prove the original statement.

One of these would show results obtained when the centrifugal force alone was in control; the second, on the contrary, would call in a disturbing cause, thus showing the effect of an interference with the same centrifugal force. This interfering influence would represent, under the actual conditions, the attractions of some heavenly body, such as the sun or moon, both of which, we know, cause a tidal cap to follow their movements.

Let us turn to the simpler experiment, *i. e.*, when the centrifugal force alone is in control, for our desire is to contrast the results of this with the second. The apparatus best suited to our purpose is an ordinary centrifugal for the working of sugar magma, a semi-fluid. This latter is composed of crystals and concentrated syrup. In the largest size of apparatus the charge is about 1,500 lbs., and about seventy-five horsepower is required to start the apparatus as it is generally used. The purpose of the process is to separate the crystals from the syrup, and in so doing the magma is thrown against the circumference of the revolving basket, the direction in which it is thrown and its distribution in this basket indicating the direction of the stresses reigning therein; on this account it answers our purpose completely, for we are seeking the results of the application of such forces to fluids, and the semi-fluids employed simply facilitate the matter because they move slower.

As the circumference is perforated with numberless holes the syrup escapes, leaving the crystals quite compactly in place, and recording, as stated, the influences they have been subjected to. To begin the trial the magma is run into the cylindrical basket, filling it about one quarter full. Then the power is applied and the basket begins to revolve, first slowly, then with rapidly-increasing velocity. The basket is suspended in such a manner that it can oscillate somewhat, its bearings being fitted with rubber springs, which can yield slightly in all directions.

Under the action of the centrifugal force the upper surface of the magma becomes more and more depressed at the centre, the mass moving so as to place itself at the greatest possible distance from this point, until finally it wedges itself against the walls at the circumference, standing vertically. When the maximum velocity has been acquired, we hear the syrup being thrown off, and in a few seconds the apparatus can be stopped. The crystals, no longer floating, ordinarily retain their relative positions and can be inspected at leisure.

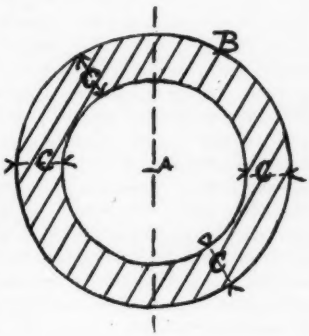
It is important that we should appreciate just what has taken place. We are

usually more impressed with results when we feel them acting directly upon our system. Hence a comparison tending to make us realize the energy involved in a sudden impulse we have thus experienced will aid us to take in the whole situation ; in consequence we note that the impulse upon the independent crystals by the centrifugal force can be compared with our personal experiences when we find ourselves standing among a number of passengers, in a vehicle in rapid motion just as the brakes are suddenly applied.

The results are unmistakable, for we find ourselves hurried forward to the limit of motion and pressed against the retaining walls.

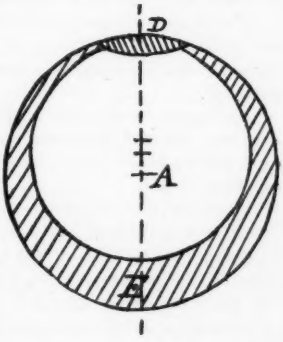
If we should, while in this position, have a photographic snap-shot taken of the crowd, the results would be comparable to the view obtained representing the positions of the crystals, hurled in their several directions and left stranded by the syrup ; this act instantly converting our semi-fluid into a fixed mass.

Our first experiment, as described, is performed thousands of times daily in the ordinary course of manufacture ; the results are constant and well known.



If we represent a horizontal section through the basket by a circle, having the circumference at B, and the centre of motion at A, we find the standing wall of sugar can be shown by a second circle, drawn concentrically with the first ; for the distribution of sugar at all points is found to be even, and its thickness, C, the same everywhere.

We now come to the variation of our experiment, the introduction of a disturbing cause, an imitation, in our small way, of the effect produced by the sun or moon upon the fluids found upon the surface of the earth when subject to rotation. Our purpose is to compare the distribution of sugar particles found under the new conditions with the above, and to note their motion relative to the weight D. This latter we secure to the basket to represent an unequally distributed or local load, the weight of a tidal cap. No other change to the apparatus is required. The experiment can commence.



We find immediately that the oscillations of the basket are more violent, possibly dangerously so ; finally, upon repeated trial, we discover that the weight of D cannot exceed a fixed proportion of the weight of the charge without excessive oscillation ; even then the apparatus must be started with judgment and skill, or it may damage itself.

The point A, the mechanical centre of the basket, is seen to revolve in a circle ; as the charge is distributing itself through the basket, this circle described by A becomes gradually smaller in diameter ; in the same measure the speed can be increased until the point A runs true or is apparently stationary, when full speed can be reached ; the syrup purges as before and the operation is complete; the basket can be stopped

and the contents examined. The distribution is found as shown at E on sketch, where the maximum thickness is located on a line diametrically opposed to the weight D. It becomes evident that the oscillations which were threatening at the start, caused an attempt to counterbalance the weight D; this it was necessary to do gradually before the speed could be much increased; it became possible when a limit was found, and it was ascertained that this weight must be reduced until it could be counterbalanced by the weight of the charge, in such positions as it could reach, under existing conditions.

When all these conditions were arrived at the experiment could be completed.

Now, it is well understood what laws were acting within the machine, and why the distribution was as found; it is argued that precisely similar results must follow in the larger-scale phenomenon we are attempting to imitate. It is obvious that in attaching the weight D to the basket we have altered its centre of gravity, and it is well understood that in attempting to start the apparatus with the weight D as well as the charge, the basket must revolve upon the new centre of gravity of the rotating mass; evidently this could no longer correspond with the mechanical centre of the basket, hence the motion of this latter point A in a circle around the new centre of gravity. During this oscillation the basket was moving in an ever-changing plane; it is a well-known fact, shown by the gyrostat, that when a revolving mass is forced to move from its plane of revolution a stress is introduced endeavouring to cause it to return thereto, and when brought back tending to produce that sense of quasi-rigidity against further movement; while being forced back, however, this stress reigns throughout the whole mass. In this case the semi-fluid masses responded. The oscillation in the manner described, sent out our little passengers, the sugar particles, where we found them doing this work, counterbalancing the disturbing cause. We saw the remedy was effective, because the circles that A was describing were gradually reduced in size, until the point A ran true, with quasi-rigidity, and the effort of D was counterbalanced.

Thus a second wave was formed, diametrically opposed to the point of application of D, and of equal size, as far as the materials were provided to form the same. From this it would apparently follow that when a tidal cap is produced upon a rotating body, and a fluid mass is situated thereon, the latter endeavours, to the extent of its ability, to counterbalance the moving weight.

Carried to its extreme, this means that, aided by the rotation, the Diurnal wave will produce the Semi-Diurnal, or any part thereof permitted by the surrounding conditions. This latter may be a bore limited to such fluid masses as the circumstances permit of.

As regards the expenditure of energy in maintaining the original wave, it is evident that, owing to the presence and reaction between two heavenly bodies, say the earth and the moon, equal amounts of energy are being continually produced and expended in each.

Practically, then, the rotation of the earth produces the original wave; with this in existence we have shown how the companion is produced and maintained. Upon close inspection the thickness of the counterbalancing deposit, in the last experiment, is found to taper off gradually, in the basket, in both directions. This is an indication that, under the stress, material is furnished equally from both sides, and that there is no liability to furnish an excess in or by the direction of motion. There is, then, equal reason to expect a bore from the west as from the east.

It is evident that if either wave be temporarily arrested by obstructions in its path the existence of the second will tend reciprocally to aid in the reproduction of

its companion, by the law, as shown. Either wave may be arrested to such an extent that the remainder, continuing upon its course, may be recognized as a bore, but its energy in either case comes from the rotation of the earth's mass. One of the conditions controlling its size is the extent of the companion wave existing in the plane of rotation and distant 180 degrees.

The approach of an ordinary ocean billow to an extended coast can be likened, as a miniature process, to that of one of these tidal waves.

Its source of energy is, to be sure, the winds of heavens, instead of the rotation of the earth, while both can be increased and decreased by the former agent; but in neither phenomenon can the expenditure of energy, by the pounding upon the coasts or into sinks, be mistaken as the cause. The arrival of one of these ocean rollers upon the variegated obstructions of a rocky coast, when watched from the beach, would seem to account for all the vagaries of any bore.

At one instant we see the main wave variously subdivided, forcing its way through obstructed channels, reach the shore in such a manner that the energy of the parts seems added together, and it shows a maximum effort; a second later another subdivides and the parts reunite so that their energies are antagonistic. The result is a minimum.

The number of possible changes between these extremes is endless, and the changes apparently inexplicable.

JOHN V. V. BOORAEM.

MANUFACTURES OF THE UNITED STATES.

BY

HENRY GANNETT.

The Census Office has recently issued complete figures concerning the manufactures of the United States and the several States, with summaries of the principal industries. These figures present a marvellous picture of growth, which is set forth in the following table, showing the principal figures of this branch of industry from 1850 to the beginning of the present century.

COMPARATIVE SUMMARY, 1850 TO 1900, WITH PER CENT. OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.					
	1900.	1890.	1880.	1870.	1860.	1850.
Number of establishments.	$512,726	$355,415	$253,852	$252,148	$140,433	$123,025
Capital	9,874,664,087	6,525,156,486	2,790,272,606	2,118,208,769	1,009,855,715	533,245,351
Wage-earners, average number	5,321,087	4,251,613	2,732,595	2,053,996	1,311,246	957,059
Total wages	2,330,273,021	1,891,228,321	947,953,795	775,584,343	378,878,996	236,755,464
Cost of materials used	7,360,954,597	5,162,044,076	3,396,823,549	2,488,427,242	1,031,665,092	555,123,822
Value of products, including custom work and repairing	13,040,013,638	9,372,437,283	5,369,579,191	4,232,325,442	1,885,861,676	1,019,106,616

It will be observed that while the number of establishments has increased in the half century more than four-fold, capital has been multiplied 19 times; wage-earners, 5½ times; and wages, 10 times. The value of products is 13 times as great in 1900 as in 1850. The population of the country has, in the interim, been multiplied by 2¼. It will be seen from comparison in the increase of the number of establishments and the capital that the average of the capital per establishment has increased many times—from $4,100 up to $19,000; that the wages per hand have nearly doubled; and that the value of products per establishment has increased from $8,300 to over $25,000. The efficiency per hand—that is, the value of product per hand—has increased from $480 up to $1,260. This great increase in efficiency (one man being worth nearly as much as three men half a century ago) is, of course, due to the great increase in the use of machinery and labour-saving devices.

Among the States, New York is pre-eminent in manufactures as in many other respects, and its manufactured products are out of proportion to its population. While it contains one-tenth of the number of inhabitants of the country, its manufactured products are one-sixth those of the country. Next to it in rank is Pennsylvania with 14 per cent., Illinois with 9 per cent., and Massachusetts with 8 per cent. These four States, with 28 per cent. of the population, contribute, collectively, nearly one-half the manufactured products of the country.

The Northern States, including those lying north of Mason and Dixon's Line, the Ohio river, and the south boundaries of Missouri and Kansas, with only 62 per cent. of the population, contribute not less than 83 per cent. of the manufactures of the country; while the Southern States—that is, those lying south of the above-described line, with 32 per cent. of the population—contribute only 12 per cent., and the Western States—that is, those of the Rocky Mountain region and the Pacific Coast—contribute 5 per cent., which is very closely in accord with their percentage of population.

The following table shows in millions of dollars the value of the product of the principal items of the manufacturing industries.

PRODUCTS.	MILLIONS OF DOLLARS.
Iron and Steel	835
Blast Furnaces	206
Rolling mills, steel works, etc.	596
Slaughtering and Meat Packing	787
Lumber	567

PRODUCTS.	MILLIONS OF DOLLARS.
Flour	560
Woollen Goods	400
Liquors	340
Cotton Goods	339
Boots and Shoes	261
Printing and Publishing	223
Cars	218
Leather	204
Chemicals	202
Cheese, butter and condensed milk	131
Paper	127
Petroleum refining	124
Carriages and Wagons	121
Silk Goods	107
Agricultural Implements	101

Our iron and steel production is 6.4 per cent. of all manufactures; textiles, with the minor manufactures connected with them, such as hosiery, carpets, hats, etc., amount altogether to 967 millions, or 7.4 per cent. of all manufactures; slaughtering and meat packing, 6 per cent.; lumber, 4.3 per cent.; and flour the same. These five products, taken collectively, make 24.1 per cent. of all the manufactured goods.

NOTES ON GEOGRAPHICAL EDUCATION.

BY

RICHARD E. DODGE.

THE PLACE OF GEOGRAPHY IN ELEMENTARY SCHOOLS.—Under this title Dr. W. T. Harris, Commissioner of Education, has presented a very interesting paper in the January number of the *Forum*. In this paper the author has outlined his reasons for putting Geography next to Literature as the most important branch in the elementary curriculum, basing his ideas in reference to the value of different subjects to the child on two principles: first, that subjects must be chosen "to give the child an ability to understand his environment, and to come into mastery of it so that he can make it useful to himself"; and, second, "to develop the intellect, the memory, the judgment, or the heart."

The author then considers some of the special ideas that the pupil will gain from geography study, and states that the superficial general notions taught from a poor text by an average teacher are more important to the child than the specific notions that come later. This is a statement of opinion in which geographers cannot all agree, though general notions are of value to beginners, if they are geographically accurate and foundational.

The second reason for the importance of geography is that it gives training in observation and reasoning, and a strong plea is made by the author for a study of causal relations in geography—a subject that is now being recognized by all the better texts and teachers.

The third part of the paper is devoted to a plea for an extension of the conception of geography as used in school work, so that it will include the influence of man upon the earth about him as well as the influence of the earth on man. Much that the author calls for in reference to the "transformation of nature by man" is already being included in school work, now that emphasis is being laid on commercial geography and the geography of industrial life.

Finally, the author pleads for a decrease in the tendency to explain the essentials of all human progress as the result of physical environment.

In fact, the paper may well be called a protest against narrow-

ness in the conception of the scope and sphere of geography in elementary teaching—a protest not to be addressed to those students of general education who have already put on record their serious objections to the chaotic complexity and all-inclusiveness of geography as taught in elementary schools.

THE CHICAGO COURSE OF STUDY IN GEOGRAPHY.—For many months a special committee of teachers has been at work on a course of study for geography for Chicago schools. This committee has recently reported, and though the course outlined has not been officially approved, it has behind it a weight of support from those who are doing the work of teaching.

The course is aimed to extend from the second to the seventh year (inclusive) of school life. The second year is devoted to elementary treatment of direction, distance, the weather, and the life of children in other lands.

In the third year home geography is emphasized, with special attention to the geography of life conditions in Chicago. Observation work on climate, on the stars, and on simple phenomena of earth change is outlined here and in later grades.

The fourth year is devoted to a special study of North America, and especially to the Mississippi Valley. This work also extends to the fifth year, most of the time being devoted to the United States. The plan followed is that of teaching by so-called "types," and the topics chosen for emphasis show clearly the influence of the point of view outlined and published by Dr. C. A. McMurry, of the Normal School, DeKalb, Ill.

The latter part of the fifth year and the whole of the sixth year are devoted to the other continents, and the seventh year is devoted to an advanced consideration of North America and of the United States by physical division.

On the whole, the course may be said to follow the plan of having the life conditions lead in the earlier work, and the physical conditions lead in the later work. Some criticism might be offered in reference to the manner of study of the continents in the earlier years, but the course as a whole is more geographically strong than that of any of the large city courses known to us.

It is interesting to note that the consideration of the causes and consequences of earth motions is developed through observation and brought to a head only in the last year—very much later than usual. The course should be of great service to all students of elementary school geography, and is to be strongly commended as being very advanced.

XUM

THE SPELLING OF GEOGRAPHICAL NAMES.—Too little attention is paid in this country to uniformity in the spelling and pronunciation of geographical names and to the rules that should be adopted in applying new names. The United States Board on Geographic Names rules upon all cases that are brought to its attention, and its decisions are usually followed in Government publications and by the leading text-book and atlas-makers. This Board does not, however, conform to the rules of the Royal Geographical Society of Great Britain, which rules have especial weight in Europe, and are generally accepted by geographers.* In fact, these rules are too little known among workers in geography in the United States.

The work of teachers and of pupils, as well as of authors, would be much simplified if authoritative rules such as those of the Royal Geographical Society were conscientiously followed in the spelling of foreign names. It would be an excellent plan for the Geographical Societies of the country to join in a crusade for uniformity in reference to geographical names, and especially in reference to the naming of newly-discovered geographical features, for which the rules of the Royal Geographical Society, quoted below, seem most sensible and appropriate:

1. That before putting forward any personal or fanciful name the traveller should do his best to ascertain that no local name exists, and, where none is forthcoming, should further consider whether it might not conveniently be derived from the vicinity, *e. g.*, from an adjacent stream, or pasture, or glacier, or from some characteristic of the natural object itself.

2. That no one should commemorate himself in this manner.

That any new nomenclature which a traveller may desire to suggest should be put forward tentatively and subject to the approval (1) of the Administration of the region or country, if there is one; (2) of the Official Cartographer of the country, if it possesses a Survey Department, or of the State to which the region may belong; or (3) of the Council of the Royal Geographical Society.

SUMMER OPPORTUNITIES IN GEOGRAPHY ESPECIALLY ARRANGED FOR TEACHERS.—A careful inquiry into the question of summer opportunities for geography work at the leading universities and normal schools, as announced for 1902, shows an increasing list of courses especially adapted to the needs of teachers in elementary and secondary schools. The greatest emphasis is laid upon

*The Second Report of the U. S. Board on Geographic Names repeats (p. 19) the statement made in the First Report (p. 7):

"Most of the nations of Europe . . . . . have practically agreed upon a system of transliteration, which, with one or two exceptions, has been adopted by this Board, thus coming into practical agreement in this matter with the rest of the civilized world."

special phases of physical geography, or upon general physical geography, and upon the physical, political, and commercial geography of the United States. Most of the courses announced include a large amount of laboratory and library work, and some field work, and in every case the full material equipment of the departments is put to service, as it would be in the regular work of the academic year. Courses given under such conditions cannot but be more stimulating and more successful than sporadic courses at summer institutes.

One valuable phase of such work is the training in special personal study of the sources of geography—a training that will be of great permanent value when teachers return to the perhaps meagre but still probably greatly unused library facilities of their working places.

The attention given to the teaching of geography as a special problem is increasing, and in most courses offered the needs of teachers are constantly kept in view, and suggestions as to the teaching of special topics are given as the topics are treated in the course.

Among the courses for 1902 that deserve special mention are the following:

University of Chicago.—Physiography: Professor Salisbury. Elements of Meteorology: Dr. Goode. Elementary Ecology: Mr. Whitford.

University of Chicago School of Education.—General Geography: Associate Professor Baber. This course will include a study of physical, commercial, and political geography, in connection with the study of the continents, and will treat the selection of material for a course of study in geography.

Harvard University.—Elementary Physical Geography: Mr. Burr. This course will include the physical condition of the lands, classification of land-forms, earth as a globe, meteorology, oceanography, geographical controls of the distribution of plants and animals, geographical factors in the history of man.

Colgate University.—Physiographic Geology: Professor Brigham. Geography of North America: Professor Brigham. This course will treat the physiographic divisions of North America with reference to the history and industrial development of the several nations, especially of the United States. Laboratory Work in Grammar and High School Geography: Mr. Carney. This is a practical course to illustrate the methods and materials available

for laboratory work in geography in the grammar and high schools.

Columbia University.—General Geography: Professor Dodge. This course will deal with the shape and motions of the earth, the elements of climate, the distribution and character of the climatic regions, and the features of the weather of the United States. Geography of North America, especially the United States: Professor Dodge. This course will treat the several natural regions of the United States geographically, with a view to showing the causal relations between the environment and life.

University of Wisconsin.—Physiography: Professor Fenneman. This course will include a study of the vicinity of Madison, the Baraboo Ranges, and Devil's Lake. Geography of the United States: Professor Fenneman. An advanced course from a physical basis on the geography of the United States.

University of Missouri.—Geography of North America: Professor Marbut. This course will consider the geology, structure, relief, climate, natural resources, population, industries, and commercial conditions of the United States.

State Normal School, Terre Haute, Ind.—The Development of Land-Forms: Professor Dryer. Meteorology: Professor Dryer. Geography of the United States, Physical and Political: Professor Dryer.

State Normal College, Ypsilanti, Mich.—Teacher's Geography: Professor Jefferson. This course will offer subject-matter training in mathematical geography, climatology, and elementary physiography, and the effects thereof. Commercial Geography: Professor Jefferson. Home Geography: Professor Jefferson. This course will be particularly devoted to the use of the local "out-of-doors" by teachers of geography.

Northern Illinois State Normal School, DeKalb, Ill.—Home Geography, the Earth as a Whole, and selected type studies especially arranged for teachers: Miss Rice. Comparative Study of the Continents: Miss Rice.

GEOGRAPHY MADE EASY.—Recently the attention of geography teachers has been called to two publications of Dr. Konrad Ganzenmüller, devoted to the spelling and interpretation of geographical names. One of these papers appeared in this BULLETIN in 1887, under the title *How to Enliven Geographical Instruction, and How to Lighten It*, and was a popular account of the meaning of geographical names in every-day use.

The other paper is a private publication by the author, entitled *Definitions of Geographical Names, with Instructions for their Correct Pronunciation.* This article deals in succession with the common names of the different large countries of the world, from which the following selections from those in the United States may be quoted:

CAPE PRINCE WALES was reached by Cook, August 19, 1778, and called in honour of the ENGLISH CROWN PRINCE (William). There were discovered: FREMONT'S PEAK by FREMONT, in 1846, and PIKE'S PEAK by PIKE, in 1806. MOUNT FAIRWEATHER was so called by James Cook, because of having seen it first in CLEAR WEATHER after a violent storm, May 3, 1778. HUDSON RIVER takes its name after HUDSON, who sailed up this river in 1609. There were named: MARYLAND, in honor of Henrietta MARIA, Queen of Charles I. (1625–1649); NEW JERSEY, in honor of George Carteret, an inhabitant of the island of JERSEY in the English Channel; and RHODE ISLAND, from a fancied resemblance to the Island of RHODES. Further: BALTIMORE, from the English Lord BALTIMORE; NEW ORLEANS, in honor of the Duke Philip of ORLÉANS, who ruled in France during the minority of Louis XV. (from 1715 to 1723); NEW YORK, in honor of the Duke of YORK, afterwards King James II. (1625–1688); PITTSBURG, in honor of the English Minister William PITT (1778); and WASHINGTON, in honor of George WASHINGTON, first President of the United States (1789–1797).

Sierra Nevada=Snowy mountains; Sierra del Monte Diablo=Mountains of the Devil's Peak; Rio Colorado=Red River; Rio Verde=Green River; Rio Grande (a tributary of the Colorado)=Great River; (*rio*) San Joaquin=Saint Joachim (river); (*rio*) Sacramento takes its name from the Holy Sacrament; Llano Estacado=plain marked with stakes; Montana=mountainous country; Nevada=snowy country.

Los Angeles (in California)=the Angels; Santa Fé (in New Mexico)=Holy Faith. Franciscan friars founded a missionary station on the coast of the Pacific Ocean, in 1776, and called it after Francesco d'Assisi, the author of their Order, San Francisco, Saint Francis.

The articles are of interest for reference by teachers; but they are not sufficiently accurate and systematic to be placed in the hands of pupils, and thus are not particularly valuable as rules for solving puzzles. The question of teaching the meaning of geographical names still remains a hard one, and receives too little attention.

GEOGRAPHICAL RECORD.

AMERICA.

TOPOGRAPHY AND THE DISTRIBUTION OF OUR POPULATION.—Dr. Walter F. Willcox, Professor of Social Science and Statistics in Cornell and Chief Statistician in the Census Office in charge of the division of Methods and Results, has made a distinct departure in census work in a discussion of the area and population of the country, recently published as Census Bulletin No. 149. He has classified the area and population of the continental United States on the basis of its topographic divisions. The results of Dr. Willcox's study have to do with the influence which physiographic features tend to exert on the distribution of our population.

The boundaries of the topographic divisions of our country are not sharply defined, geographers not being wholly agreed as to their extent and number. The topographic divisions adopted by Mr. Gannett, the Geographer of the Census, and used by Dr. Willcox in his discussion, are those which are generally accepted. The boundaries of the divisions, as shown on the accompanying map, were adjusted to coincide with county lines in order that the statistics collected might be applied to each division. With this qualification the extent of each topographic division was determined by considerations of geology, topography, altitude, rainfall, and temperature. A condensed statement of Dr. Willcox's report follows:

Coast Lowlands.—A marshy area stretching along the Atlantic and Gulf coasts from New Jersey to the Rio Grande. The borders of the swamps along the Atlantic coast are being drained and converted into farms. A considerable area in the Carolinas is utilized for rice plantations. The coast lowlands, in the main, are well timbered, principally with cypress and juniper. Area, 82,807 square miles, or 2.8 per cent. of our continental area. Population, 1,865,952, or 2.4 per cent. of the total.

Coastal Plain.—A strip of land along the Atlantic and the Gulf between the lowlands and the Piedmont region. It stretches from New York Bay to the Mississippi, on both sides of which it extends northward to the Ohio river. As it is cut into two parts by the Mississippi alluvial region, it is treated in Dr. Willcox's map and tables as two divisions. The coastal plain east of the Mississippi has an area of 167,097 square miles, or 5.6 per cent. of the total. Being good farming land and having many industries, it has a far larger

TOPOGRAPHIC DIVISIONS OF THE UNITED STATES.

population in proportion to area than the coast lowlands. Population, 6,427,635, or 8.4 per cent. Area of the coastal plain west of the Mississippi, 87,726 square miles, or 3 per cent.; population, 1,974,677, or 2.6 per cent.

Piedmont Region.—Extends from New York Bay, southwest, to the western boundary of Alabama; bordered on the southeast by the coastal plain, the limit between the two being set by the Fall line, where the streams, passing from the hard granite rocks of the Piedmont region to the soft tertiary rocks of the coastal plain, have rapids, or falls, marking the limit of navigation from the sea. Manufacturing towns from Trenton, N. J., to Montgomery, Ala., use the water power thus afforded. Area, 89,920 square miles, or 3 per cent.; population, 6,809,103, or 9 per cent.

Appalachian Valley.—The narrow mountain region extending from the Hudson to northeastern Alabama between the Piedmont region and the Allegheny plateau. Most of this region forms a depression, drained in different parts by different streams. Area, 54,519 square miles, or 1.8 per cent.; population, 4,499,072, or 5.9 per cent.

New England Hills.—Properly part of the Appalachian mountain system, but is here distinguished on account of its difference in character. The mountains, instead of being disposed in parallel ridges, are mainly isolated, irregular groups, such as the hills of Maine, the White Mountains, and the Adirondacks. Area, 82,696 square miles, or 2.8 per cent.; population, 10,260,153, or 13.5 per cent.

Allegheny Plateau.—A forested escarpment extends, more or less continuously, from the Hudson river, southwesterly, to Alabama, rising from the northwestern border of the Appalachian Valley. From its summit stretches a plateau with a general northwestern slope everywhere deeply scored into cañons by streams which have cut the plateau into very irregular ridges and gorges, making it one of the most intricate mountain regions on the globe. Dr. Willcox does not mention the fact that, largely owing to difficulties of transportation, the central part of this plateau, extending through eastern Kentucky and Tennessee, is one of the least progressive parts of the country. Area, 99,539 square miles, or 3.4 per cent.; population, 6,070,246, or 8 per cent.

Interior Timbered Region.—Comprises most of Ohio, Indiana, southern Illinois, western Kentucky, and western central Tennessee. When first entered by the white man it was quite generally covered with forests. Area, 118,326 square miles, or 4 per cent.; population, 8,129,760, or 10.7 per cent.

Lake Region.—The country bordering the Great Lakes is included under this name. It is heavily forested, mainly by conifers, and is the largest source of white pine lumber and iron ore. Area, 173,302 square miles, or 5.8 per cent.; population, 9,571,215, or 12.6 per cent.

Prairie Region.—A region of transition from the forested country on the east to the barren plains on the west. On the east it merges, by insensible degrees, into the forest regions, and on the west, by equally insensible degrees, into the Great Plains. As its rainfall is rather light, most species of trees cannot thrive; the greatest region of wheat and maize, and the industries depending upon them. Area, 454,991 square miles, or 15.3 per cent.; population, 13,300,970, or 17.5 per cent.

Mississippi Alluvial Region—Lies mainly below the high-water mark of the rivers traversing it. The rivers, by deposit, have built low, flat ridges along their courses, which, except in times of extraordinary floods, confine them and protect the lower country. The only habitable parts are these river ridges, the lower country consisting of swamps. Thus, throughout this region the habitable portion of the land forms but a small part of it. These river ridges are well cultivated; in Louisiana, mainly in sugar, while higher up on the river almost the sole crop is cotton. The soil is extremely fertile. Area, 41,713 square miles, or 1.4 per cent.; population, 1,227,094, or 1.6 per cent.

Ozark Hills.—The southern portion, in central Arkansas and the Indian Territory, is composed of winding ridges of quartzite separated by limestone valleys; the northern portion, in north Arkansas and south Missouri, is a plateau sloping northward, and deeply scored by cañons. Area, 62,195 square miles, or 2.1 per cent.; population, 1,203,880, or 1.6 per cent.

Great Plains.—They merge insensibly with the prairie region, the line between them being set at the line of normal annual rainfall of twenty inches. The rainfall is insufficient for agriculture, and irrigation is necessary, the available water sufficing for only a small part of the land. The plains are occupied mainly by cattle and sheep. Area, 460,994 square miles, or 15.5 per cent.; population, 1,052,719, or 1.4 per cent.

Cordilleran Region.—The Great Plains form the long eastern slope of a plateau, the summit of which extends to the Cascade Range and the Sierra Nevada. A vast number of mountain ranges and plateaux and elevated valleys are on the slopes and summit of this plateau. Except in western Oregon and Washington, the climate

is arid. Forests are found, as a rule, only upon mountain ranges and the highest of the plateaux. This region has been subdivided into several areas.

Rocky Mountains.—The division includes the most eastern of the mountain systems in the Cordillera. It is composed of a series of ranges separated by valleys trending parallel to one another. Area, 296,220 square miles, or 10 per cent.; population, 592,972, or 0.8 per cent.

Plateau Region.—Comprises most of the drainage basin of the Colorado river. Every stream is in a cañon; and as the rainfall is light, most of these cañons are dry during the greater part of the year. The higher plateaux, having ample rainfall, are green and forested; while the lower plateaux are covered with sparse vegetation or are absolutely sterile. Area, 188,422 square miles, or 6.3 per cent.; population, 201,699, or 0.3 per cent.

Great Basin.—Has no drainage to the sea. The only outlet for its waters is by sinking into the thirsty soil or by evaporation. With the exception of the country along the lower Colorado and Gila rivers, this is the most desert part of the country. Area, 229,869 square miles, or 7.7 per cent.; population, 375,345, or 0.5 per cent.

Columbian Mesas.—The area drained by the Snake river, and most of that drained by the Columbia above its passage through the Cascade Range, has been in great part covered by eruptions of basalt, which, bursting through the overlying rock, spread over the country, and form great table lands for thousands of square miles. Area, 112,525 square miles, or 3.8 per cent.; population, 356,758, or 0.5 per cent.

Pacific Valley.—Lying parallel to the Pacific coast a short distance inland is a great depression, extending from British Columbia southward into southern California. The regions along some of the rivers and other bodies of water in this depression, as Puget Sound, the Willamette river of Oregon, and the Sacramento and San Joaquin of California, are among the most fertile regions of the Pacific slope. Area, 106,549 square miles, or 3.6 per cent.; population, 995,363, or 1.3 per cent.

Coast Ranges—Separate the Pacific Valley from the Pacific Ocean. These ranges, trending parallel with the coast, are heavily timbered in Oregon, Washington, and northern California, but are almost devoid of forests in southern California. The valleys, especially in southern California, are very fertile, and produce a great variety of fruits, many of which are tropical. Area, 60,820 square miles, or 2.1 per cent.; population, 1,079,992, or 1.4 per cent.

The Great Plains are thus shown to be the most extensive topographic division, closely followed by the prairie region, the two together including nearly one-third (30.8 per cent.) of the continental United States. The eastern boundary of the Great Plains about bisects the country, 49 per cent. of the area of the continental United States lying west of that north and south line, and 51 per cent. lying east of it.

The prairie region and the New England Hills include over three-tenths, or 31 per cent., of the population of the country; while the Lake region and the Interior Timber region include over one-half, or 55.3 per cent., of the population.

ASIA.

DEVELOPMENT OF KIAO-CHAU.—The *Revue de Géographie* (XXV, 2, 1901) gives an account, by Mr. André Brisse, of the progress of the German colony in China. Sixteen hundred German soldiers and 200 civilians, besides 80,000 Chinese, are living in the German concession and in the "Neutral Zone." The concession borders Kiao-chau Bay; the Neutral Zone extends inland from the concession, is eleven and a half miles wide on an average, and is practically under German protection. The Chinese town of Kiao-chau is in the Neutral Zone, and has little importance in comparison with Tsingtau, at the entrance to the bay, which has been transformed by the Germans from a Chinese village to a modern town, lighted with electricity and having the telephone and other urban conveniences. Tsingtau is the starting-point of the railroad which the Germans are now building across Shantung province.

The climate is fairly healthful, particularly since hygienic measures have diminished the prevalence of fevers. The harbours in the large bay have not equalled expectations; but two artificial harbours are now being constructed, one of which will have a depth of ten and the other of six metres. The deeper harbour will be completed, it is expected, in 1906. The Chinese had almost entirely denuded the region of trees, and in consequence a great deal of the soil was washed away by torrents. The German administration is now giving much attention to tree-planting.

No evidence of minerals or coal has been found on the concession, though the prospect of coal mining along the line of the projected railroad is excellent, and iron is also abundant in the province. The intention of the Germans is not only to make Kiao-chau bay important as a coaling station and a commercial

centre, but also to tap the resources of the rich Shantung province. The main agency in this work will be the railroad now building from Tsingtau to Tsinan-fu, in the western part of the province. The commerce of the colony is as yet small.

RUSSIAN FARMERS IN THE KIRGHIZ STEPPES.—North of the Aral Sea are the wide, low, grassy Khirgiz steppes, inhabited by the steppe Kirghiz, nomad herdsmen, who have no settled abode, but move over their plains as the whim seizes them or the need of pasturage for their herds requires. Important changes are occurring in this region, owing to the incoming of Russian immigrants. The present inhabitants are the native Kirghiz, the Cossacks and the Russian peasants, who are entering the country in large numbers, 24,602 having arrived there in 1900. The new settlers are occupying many of the fertile tracts, each new settlement meaning a loss of pasturage to the enormous Kirghiz herds and flocks. The natives have little aptitude for any vocation except raising cattle and sheep and hunting, while the newcomers are farmers. As the Kirghiz have no desire to acquire Western ideas, it seems probable that, as the grazing lands for their live stock decrease, the animal industry will diminish and the Kirghiz themselves will dwindle in number. The Russian immigrants are prospering, though the scarcity of water is an uncomfortable condition in many places. It is hoped to improve the water supply by digging wells. According to Mr. Labbé, who has reported the above facts, the plain presents excellent commercial opportunities (*Questions Diplomatiques et Coloniales*, 1901).

EUROPE.

ARE THERE LAKES IN THE CAUCASUS?—Professor G. Richter points out that Merzbacher's recent work, "Aus den Hochregionen des Kaukasus," repeats the familiar statement that the Caucasus Mountains are devoid of lakes and waterfalls. This is very remarkable, as the Caucasus consists, for the most part, of a true mountain chain like the backbone of the Alps, and, no less than the Alps, the mountains have been subjected to glaciation. Lakes and waterfalls, when found among the higher mountains, are signs of glaciation, so that their absence in the Caucasus remains to be accounted for.

The author is of the opinion that lakes do exist there, and will be found when explorers devote attention to the lateral valleys instead of confining themselves to the region still occupied by glaciers. He compares our knowledge of the Caucasus with that

which would have been obtained of the Alps if exploration had been confined to Chamonix, Zermatt, and the Bernese Alps. Richter believes that rightly-directed exploration will also reveal waterfalls in the Caucasus. There can be no doubt that marginal lakes (Randseen) are absent in the region; and this proves that the glaciers did not extend down over the plains. All the Swiss marginal lakes of large size lie in moraines at the end of old glacier beds; where, as in the case of the Mur and Enn glaciers, the glacier stopped in the mountains, lakes are absent. The glaciers of the Caucasus must, therefore, have been of this character. (*Geographische Zeitschrift*, VII) *Scot. Geog. Mag.*, March, 1902.

IMPORTS OF VEGETABLES INTO SWITZERLAND.—The "*Journal de la Société d'horticulture de France*," 1901, says that the importation of fresh vegetables into Switzerland in the tourist season last year amounted to 20,000 tons, the larger part coming from Germany, though the importations from France and Italy were also important. The Swiss Government is now endeavouring to encourage the larger cultivation of vegetables in order to reduce the imports. Beef cattle and other food supplies are also purchased to a great extent from neighbouring countries. As mountains cover more than half of the country, Switzerland cannot raise the enormous quantities of food consumed by tourists. In fact, Switzerland derives less support from agricultural resources than any other country in Europe, except Norway. Only about a sixth of the area of the country is capable of cultivation.

A WATER ROUTE TO SWITZERLAND.—Switzerland is the only important country in Europe, except Servia, that has no sea coast. According to one of our recent *Consular Reports*, Mr. Gelpke, a young Swiss engineer, has submitted a plan to the Government for an all-water route from the city of Basel to the North Sea. Basel, on the Rhine, is about 400 miles from Rotterdam, the nearest port on the North Sea. Mr. Gelpke proposes to render the Rhine navigable for freight steamers at all seasons of the year by regulating its water-level. He suggests that fourteen dams be built between Basel and Mannheim to raise the water-level along that stretch of the river. Mr. Gelpke's plan is receiving consideration from the Government, as well as another project, which is to build a canal from Basel to connect with the famous Rhine-Rhone canal that now enables small Rhine boats to travel all the way to Marseilles. The Rhine-Rhone canal starts from Mülhausen, on the Rhine, and extends in a southwest direction to the Doubs river, which is a navigable tributary of the Rhone.

OCEANIA AND AUSTRALIA.

A NEW SOURCE OF PHOSPHATE.—Ocean Island, a little rock in the Pacific somewhat south of the Equator and 200 miles west of the Gilbert group, appears on few maps, and has been little known. Its native name is Paanopa. According to the *North China Herald*, rich deposits of phosphates, found some time ago on this island, are now being shipped to Australia and New Zealand to fertilize the fields, just as the phosphates of Chile are sent by millions of tons to spread over the cultivated lands of north Europe. There is no good anchorage; but mooring buoys have been placed on two sides of the island, to which steamers may make fast while loading the phosphate brought to them on lighters. There is deep water close to the shore. The phosphate industry is carried on by the Pacific Islands Company, which has secured exclusive rights, and employs 220 hands. The island has recently been annexed by the British Government. It is about 1,600 miles from Brisbane, Queensland.

AUSTRALIAN TRANS-CONTINENTAL RAILROAD.—*Globus* says that a railroad is to be built from Fort Augusta, on the south coast of Australia, to the Coolgardie mines. As these mines are connected by rail with Perth, on the west coast, the enterprise will complete the first trans-continental railroad in Australia.

The road will run quite near the sea, where a telegraph has for years connected the eastern and western coasts of the continent. Nine-tenths of the mileage will be through one of the most barren deserts in the world; but the building of railroads through deserts no longer offers unknown problems to engineers. This railroad will complete the connection by rail of all the important centres of population in Australia, excepting some isolated settlements on the north and northeast coasts. Heretofore, it has always been necessary to travel by sea between Perth, Fremantle, and Albany, the most important towns in western Australia, and the more developed regions of Victoria, New South Wales, and Queensland.

AFRICA.

DODSON'S TRIP IN THE SAHARA.—A large part of the Hinterland of Tripoli has hitherto been forbidden ground. This little-known region, according to the *Scottish Geographical Magazine* (March, 1902), has just been traversed by Mr. Edward Dodson. He succeeded in mapping considerable new country, and collected data for alterations in the existing maps. After reaching Sofejin, about 120 miles south-

east of the city of Tripoli, he made a detour to strike a Roman reservoir, where it was expected that water, a scarce commodity, might be obtained. This reservoir, a fine piece of ancient stone masonry, was found in a remarkable state of preservation; the cement had not been impaired and the structure was water-tight. Along the route patches of brilliantly-colored flowers were found in the dried beds of torrential streams. They were of the nature of "everlasting flowers;" for, brilliant as they appeared, they had been completely dried by the heat and drought.

Further south, the people of the Bonjem oasis were found to be nearly starving, as the failure of water had reduced them to subsisting on snails and date-palm juice. Buildings erected here during the Roman occupation are in excellent condition; one of them covers an area of 3,600 square yards, with a gateway twelve feet thick. These buildings are in striking contrast with the miserable structures erected later by the Arabs. The four days' journey from Bonjem to Sokna involved intense suffering, as the party was without water. Sokna, already well known, is a small oasis with a population of 2,000 and a Turkish garrison of 200 men. In continuing the journey to Murzuk, some 300 miles further south, the Jibil Soda, or Black Mountains, were crossed. The Black Mountains consist of large slabs of perfectly black stone, and are difficult to cross. Ten hours were occupied in traversing a great petrified forest, in which the trees, all lying prone, vary in circumference from two inches to seven feet. Marine shells, found all through the forest, show that this region was at one time submerged by the sea.

POLAR REGIONS.

ACCORDING TO *Petermanns Mitteilungen*, Band 48, III, the Norwegian professor Birkeland will this year visit Jan Mayen and establish a station for the study of the Aurora Borealis. The Norwegian Government has made an appropriation of 20,000 crowns ($5,400) in aid of the project, on the supposition that the remainder of the amount required (which is not specified) will be forthcoming from other sources.

AN EXPEDITION SENT OUT by the Russian Ministry of Marine will explore the Kara Sea during the summer of 1902.

A LETTER FROM A. BIRULA, zoologist and botanist of Baron Toll's expedition to the New Siberian Islands, to a St. Petersburg paper, establishes the fact that the position assigned to Sannikov

Land by the expedition of 1886 was erroneous; the *Saria* having passed the spot four times without sighting land.

Bennett Island was approached within 14 nautical miles; it was marked by its white peaks above the glaciers and deep valleys, and wholly unlike the Asiatic shore.

Nordenskiöld Sea was free of ice between Cape Chelyuskin and the New Siberian Islands, and north of the Lena-mouth the temperature of the water was above 35 degrees, Fahr.

The Imperial Academy, it is announced, has resolved to push the exploration no further for the present, in view of the difficulties in the way of forwarding supplies of coal. The party will return by land, and the ship will be left at the New Siberian Islands.

Capt. Roald Amundsen, first officer of the *Belgica* in her Antarctic voyage, laid before the Norwegian Geographical Society, in November last, his plan of an expedition to determine the position of the magnetic North Pole. In his address Capt. Amundsen quoted Ross's description of his arrival, on the 1st of June, 1831, at the spot in Boothia Felix, where the dipping-needle showed an angle of 89° 59′ with the plane of the horizon. The magnetic pole was then practically reached, and its geographical position was fixed by Ross in 70° 5′ N. Lat.; 96° 47′ W. Long.

Two questions have since presented themselves:

(1) Whether the magnetic pole is a mere point, or a large area, over which the needle assumes a vertical position;

(2) Whether the magnetic pole is stationary or changes its position.

Capt. Amundsen will endeavour to find answers to these questions. His purpose is to start in the spring of 1903 in the *Gjöa*, a sloop, fitted with a petroleum engine, and provisioned for four years for the party of seven men.

Besides an ample supply of meteorological and oceanographic instruments, Capt. Amundsen will take a travelling magnetometer, especially designed for him by Prof. Neumayer, Director of the Deutsche Seewarte, at Hamburg, and an inclinatorium, or dipping-needle, now under construction by Dover, of London.

The course will be to the west coast of Greenland, where dogs will be procured, and thence through Lancaster Sound and Prince Regent Inlet to Bellot Strait, and along the west coast of Boothia to the spot of Ross's magnetic pole, where a depot, or cache, will be left. A winter haven will be established either on Matty Island or on King William Land. The autumn of 1903 will be devoted to

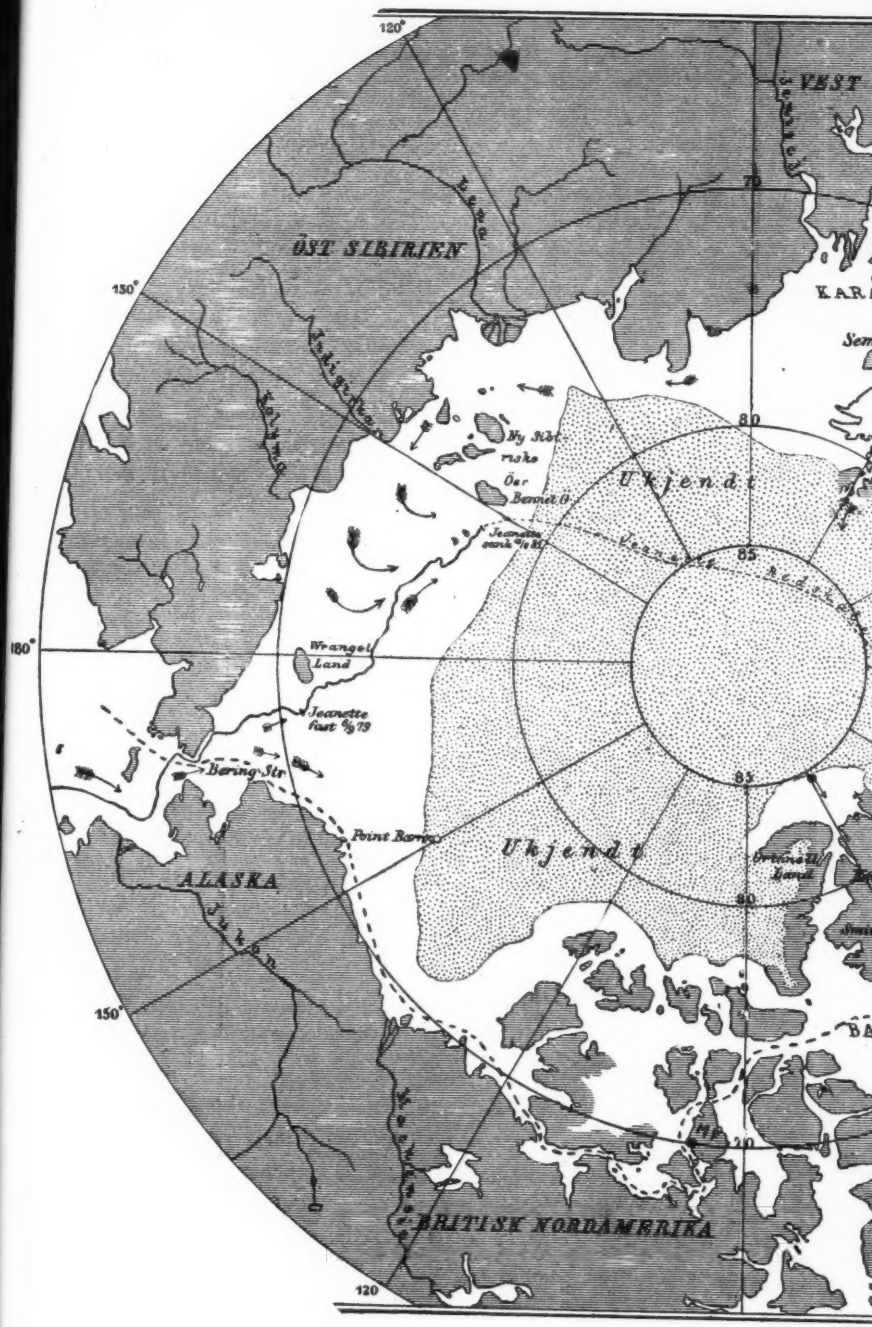
making depots for the following year; and the winter to magnetic and meteorological observations. When the severest cold is passed Capt. Amundsen will set off with three men and two sledges for Boothia to study the region around the magnetic pole, and make the greatest possible number of scientific determinations. This part of the programme he hopes to carry out before the setting in of winter.

If successful in this he will establish himself, with one companion, near the magnetic pole, and there pass the winter of 1904–5, building snow-huts for a house and an observatory.

His scientific work once done, Capt. Amundsen intends to make the return voyage by way of the Northwest Passage and Bering Strait.*

THE SCOTTISH ANTARCTIC EXPEDITION.—The *Hekla*, the vessel purchased for this expedition, arrived at Aberdeen from Norway on the 10th of February, and is undergoing alterations by the Ailsa Shipbuilding Company at Troon. The sledges, skier, kayaks, and some of the woollen clothing will be made in Norway, and Dr. Nansen will supervise the work.

* The Norwegian map is contributed by Mr. H. L. Bridgman.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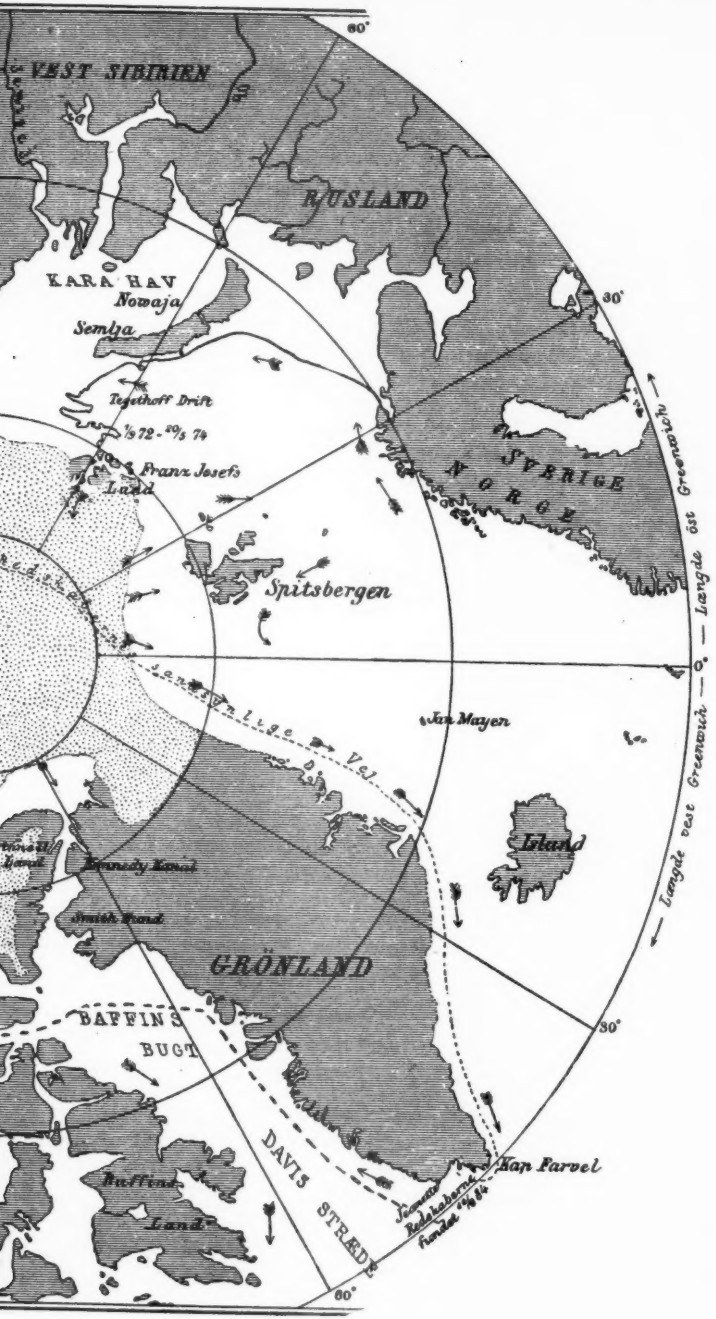
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MAP NOTICES.

BY

HENRY GANNETT.

Since the last notice the U. S. Geological Survey has published twenty additional sheets of the Atlas of the United States. Among these only one lies in New York, and represents a bit of the south shore of Lake Ontario in Wayne County, under the name of the Poultneyville sheet.

In New Jersey is one sheet, Navesink, on a scale of 1:125,000, with contours at 20-foot intervals. It is situated in the eastern part of the State, and comprises the coast from Sandy Hook to a point six miles south of Bay Head, extending into the interior sufficiently far to take in New Brunswick. It is a reduction and reproduction of four sheets upon the mile scale.

The country about Niagara Falls and Buffalo, including the entire length of Niagara river, is represented upon a sheet of irregular shape and size, the scale being 1:62,500, with a 20-foot contour interval.

In Pennsylvania are four complete sheets, besides parts of other sheets. The four complete sheets are Indiana, Kittanning, Latrobe, and Tioga. They are upon a scale of 1:62,500, with contour intervals of 20 feet. These represent areas in the northern or western parts of the State in the Allegheny plateau. Here the plateau is deeply dissected by stream valleys, with little appearance of system either in the valleys or ridges.

The four sheets, which include Philadelphia and its environs, have been printed to get her in onemapupon a scale of 1:62,500, with a contour interval of 20 feet. This is a very useful map, and it includes a large area covered with dense settlement.

There are seven sheets representing, in the main, portions of Maryland, most of them containing also parts of other States. They are all upon a scale of 1:62,500, with contour intervals of 10 or 20 feet. Upon the Eastern Shore are Snow Hill, entirely in Maryland; Salisbury, in Maryland and Delaware; Princess Anne, in Maryland, and Virginia and Green Run, in the same two States. The first three of these sheets represent low-lying country, traversed by marshy, sluggish streams, and whenever they include the sea-coast it is low, and bordered by belts of marsh. The last, Green

Run, includes Chincoteague Bay and the sand bar separating it from the Atlantic Coast. The Gunpowder sheet lies upon the west shore of Chesapeake Bay, and represents a rolling country sloping down to a somewhat marshy coast. Parkton, which lies mainly in Maryland, with a narrow strip of Pennsylvania on the north, lies west of the head of Chesapeake Bay, and represents a rolling country of no great relief. Hancock, which includes parts of Maryland, Pennsylvania, and West Virginia, lies near the westward end of Maryland, in the mountainous region, and is traversed from west to east, in a great curve, by the Potomac river, which here cuts a succession of gorges through the ridges which run across the country transverse to the course of the river.

In Wisconsin is one sheet, Portage, on a scale of 1:62,500, with a contour interval of 20 feet.. It represents a country of irregular glacial hills, with many swamps, small lakes, and crooked winding streams; a region whose surface has been diversified by the Laurentian glacier.

In Indiana and Kentucky is the Owensboro sheet, which, on a scale of 1:62,500 and contour interval of 20 feet, represents a portion of the valley of Ohio river. The valley is a road, extending from north to south across the sheet, and is elevated a little above the river level. Here and there, however, are hills standing up above the general low level of the bottom lands.

In Iowa there is one sheet, known as Oelwein, on a scale of 1:62,500, with a contour interval of 20 feet. It represents in the main a high rolling prairie, considerably dissected in the southeastern part by streams flowing to Volga and Turkey rivers.

The Joplin lead and zinc region in southwestern Missouri and southeastern Kansas is represented upon a special map on a scale of 1:62,500, with a contour interval of 10 feet. This sheet comprises an area of about 500 square miles, or the equivalent of two Atlas sheets. This region, which now produces most of the zinc of the United States, as well as a notable part of the lead, consists in the main of a high rolling prairie, traversed by the broad flood plains of several large streams, and much dissected near the margins of their valleys. Here have grown up several important centres of population induced by the mines, such as Joplin, Carthage, Webb City, and Galena.

In Wyoming is one sheet, Mount Leidy, situated in the western part of the State, south of the Yellowstone Park and east of Jackson's Hole. The scale is 1:125,000, and the contour interval is 100 feet. The country consists of high, bold mountains, the Conti-

nental Divide, separating Wind river from the Snake, traversing the eastern part of the sheet, while the bulk of the sheet is made up of heavy spurs running westward from the summit.

In Oregon are two sheets, both situated in the eastern part of the State and adjoining one another, known as Baker City and Sumpter. The scale is 1:125,000, and the contour interval 100 feet. Sumpter represents a portion of the crest of the Blue Mountains, here rising to altitudes of 9,000 feet, with the spurs on the east dropping down to the valley of Powder river and the broken country upon the west. The Baker City sheet represents a portion of the Blue Mountains, with the upper valley of Powder river, here flowing northward.

That portion of Southern California lying between latitudes 32° 40′ and 33° 40′ and longitudes 116° 30′ and 118° 30′, including the highly-settled and developed region from Los Angeles, southward, with the mountain ranges bordering it, together with the southern edge of the Mohave Desert, are represented upon a single sheet, upon the scale of 1:250,000, with a contour interval of 250 feet. About 8,000 square miles are represented upon this map, which brings together the great ranges of San Gabriel and San Bernardino, which supply water to the extremely fertile valley to the southward, and the San Jacinto Mountains, which also contribute to watering this region. The scale of detail is sufficient to suggest, at least, the beautiful alluvial cones built up by the streams entering the valley from these mountains. This is the most extensive artesian area on earth.

In Alaska is one sheet, Forty Mile, comprising the area lying between latitude 64° and 65° and longitude 141° and 142°, an area of about 2,600 square miles. It is on a scale of 1:250,000, with contour interval of 200 feet. It represents a deeply-dissected plateau rising from the Yukon, which crosses its northeast corner at an altitude of about 500 feet above sea-level, up to over 6,000 feet in the highest summits, while the general level is a little above 3,000 feet.

Using the well-known map of the District of Columbia, on a scale of 1:62,500 as a basis, a map of historical geology has been issued by the Geological Survey.

The Standard Map of Connecticut, prepared under the direction of Joseph R. Bien, Julius Bien & Co., publishers, New York, 1902. Scale about 1 6-10 miles to an inch.

The streams are represented in blue, culture in black and red,

and the relief is expressed by brown crayon shading. The boundaries of the towns, cities, and boroughs are emphasized by bands of color. The map is, in the main, a reproduction of the Atlas sheets of the Geological Survey, with a revision of the cultural features, and a change in the method of expressing the relief. It shows all the railroads, country roads, and the street plans of cities. An added feature is the representation of trolley lines in the cities and rural districts. These have had wonderful development in recent years.

Printed from stone, the execution of the map is all that could be desired.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, March 20, 1902.

Next to the Société de Géographie, the most numerous and the most important of the French geographical societies is the Société de Géographie Commerciale de Paris. This association had its origin at the close of the year 1873 in the recognized necessity of turning to practical account the discoveries made by explorers. To bring scientific travellers into relation with merchants and manufacturers and to extend the knowledge of the products of other countries, as well as to indicate the readiest means of communication—to devote themselves, in one word, to the advancement of economical geography—this was the aim of those who founded the new association. They began as a Committee on Commercial Geography in the bosom of the Société de Géographie itself, directed by such men as M. Meurand and M. Charles Hentz, and assisted by the good-will of many others; but the need of an independent organization made itself felt, and the present Society entered upon its work in 1876. It was at first without a special organ, and it made but slow progress. It now constitutes a body of more than 2,000 members, with an administrative Council of between 30 and 40 members, a President—Prince Roland Bonaparte—and 4 Vice-Presidents, a Secretary-General and two Secretaries, a Librarian, and a Treasurer. There are three sections: one charged with Economical Geography in general, one with the geography of France and the French Possessions, and one with the study of foreign countries.

Each of these has its own Council and holds its special monthly meetings. The proceedings of the Society, as well as those of the Sections, and the papers contributed, find their place in the Bulletin, which has been edited since the year 1878 by the General Secretary, M. Gauthiot. The Society does not manifest its interest in explorations only by publishing papers on subjects of geographical and economical import; it bestows medals, as rewards for remarkable journeys, or for special researches in France, in Europe, in Asia, in Africa, America, or Oceania. Furthermore, the P.-F. Fournier Fund enables the Society every year to assist an explorer designated by the Committee on Prizes.

For students and workers the Society's library affords a collection of contemporary literature in general geography as well as in

the economical branch, besides an assortment of more than 4,000 specimens of products, natural and artificial, from all parts of the world; one particularly deserving of mention from Chile, contributed by Messrs. Wiener and Pra.

The activity and ability of the General Secretary count for much in the influence of the Society and its participation in important enterprises.

There is room for improvement in the Bulletin de la Société de Géographie Commerciale, as well in the text as in the style of its maps; but with all this, it is a publication of real value.

There are sections of the Society, outside of Paris: one, la Stéphanoise, at Saint-Etienne, and another at Tunis.

It is hoped the Guiana Section will soon be revived and that similar branches will be formed in other colonies.

The colonies naturally draw to themselves the energies of our explorers. These will be greatly aided in the geological reconnaissance of new countries, in the study of their botany, and in anthropological, linguistic, and historical researches, by the practical instructions under the form of Notices, drawn up and issued by *La Revue générale des Sciences Pures et Appliquées*, with the collaboration of M. Alfred Le Châtelier. The first of these Notices, already distributed, relate to Dahomey and the Military Territory of the Tchad.

With the scientific study to which some devote themselves, progress is also made in popularising the knowledge already acquired. Dr. Blanchard, whose work in this direction last year on Madagascar received the support of the Union Coloniale Française and the Comité de Madagascar, is now doing a similar work on Tunisia with the assistance of specialists, and the fourteen lectures delivered at the Museum of Natural History on the geography, the climate, the fauna and flora, the peoples, the history, etc., of this region will constitute, when brought out in book form, an inventory of our knowledge of Tunisia at the beginning of this century.

The admirable articles on the oases of Suf and M'Zab, published by M. Jean Brunhes in *La Géographie*, call for notice. Of cartographical importance are the geographical co-ordinates communicated to the Academy of Sciences by M. G. B. M. Flamand; they fix the position of different places in the Oran Sahara, and in particular that of In-Salah. A service of a similar kind, though based upon data less rigorously exact, is that performed by M. Clozel in the lower Ivory Coast; he shows the feasibility of uniting by water the Grand Bassam Lagoon with that of Assinie. M. Bonnel de

Mézières, of the Franco-Spanish Commission, reports the determination of the sources of the coast river Como and the identification of the N'tem with the Rio Campo; while in the French Congo the travels of Capt. Julien between the upper Banghi and the Yeuka furnish information, made clearer by a map on the scale of 1 : 500,000. At another point Capt. Truffert has made an excellent study (printed in the *Revue générale des Sciences*) on the *massif* of the M'Bres, from which descend the valleys of the Gribingui, the Koddo, the Kemo, and the Gunda, affluent of the upper Kwango. The reconnaissance and the organization of the lower Shari are excellently treated in a communication of Comm. Robillot to the Société de Géographie, and are complemented by a paper on the upper Shari by M. G. Bruel.

Too little is yet known of what has been done in Ethiopia; and with regard to Madagascar it seems well to wait for the appearance of M. G. Grandidier's map.

In Asia, besides the journeys of M. F. Grenard among the Kurds in the summer of 1901, we have to note that a French technical Commission under M. Trémoulet has been charged with the organization of the mining service, and its explorations must result in serious additions to the knowledge of this country.

Not less important will be the studies of M. Maurice de Lobel on the American side of Bering Strait, near Cape Prince of Wales and Kotzebue Sound.

An article by M. Julien Thoulet on Branco islet (in the Cape Verde archipelago) seems to dispose of M. Doelter's theory that the Cape Verde Islands are the last vestiges of the ancient Atlantis.

Among the interesting publications to be noted is the Compte Rendu of the International Colonial Congress, held in Paris in 1900. This volume contains much information of a character useful to geographers. In another Compte Rendu, that of the section on the History of the Sciences, are two papers of moment to historians of geography: one by M. Paul Meuriot on the expression *diaphragma*, and its meaning in ancient geography; the other, by M. Siegmund Gunther, considers the cosmographic theories of the XVI, XVII and XVIII centuries.

Such subjects appeal principally to scholars, but a larger public is attracted to colonial questions.

M. Maxime Petit has just published the first volume of a Colonial encyclopædia, *Les Colonies Françaises*, the work of a number of competent writers, who contribute a series of monographs on the country, the races, the history, the conquest, the administration,

development, etc., of each Colony. This first volume deals with the possessions in Northern and Western Africa; the second, and final, volume will treat of the other colonies. The maps might perhaps be improved in some respects; the text is excellent, and the work, when completed, will fill a gap in French geographical and Colonial literature.

Mention must be made of an excellent work on the inscribed stones of North Africa by the traveller G. B. M. Flamand. This work, entitled *Hadjrat Mektoubat*, is a study, accompanied by engravings, of the first artistic manifestations in the North African region, and we welcome it as the forerunner of a *corpus* of all the known inscribed stones there found. No one is better equipped for this task than M. Flamand, who has studied the subject for ten years.

No one, it may be added, in or out of France is more competent than M. Alfred Grandidier to treat all questions relating to Madagascar. He has just published a new and important part of his great *Histoire physique, naturelle et politique de Madagascar*, the first part of the ethnographical section, on the origin of the Malagasy. The conclusion of his profound study, which is marked by a severe method, as well as by ample and thorough erudition, is that the Malagasy are mestizos, so to speak, of Indo-Melanesians and the most diverse races.

One work relating to Asia may be noted: the *Atlas Archéologique de l'Indo-Chine*, published by the Ecole Française d'Extrême Orient. In this are five maps by Capt. E. Lunet de Lajonquière, on which appear all the Hindoo monuments in Annam (maps A and B), in Cambodia (maps C and D), in the rest of eastern Indo-China (map E); the antiquities of Chinese and Annamite origin not figuring in this atlas. A descriptive inventory of the Hindoo monuments will soon be published.

An article printed in the Bulletin of the Comité de l'Asie Française by M. Pierre Padaran sets forth the economical and commercial value of Indo-China.

Attention should be called to a book on the period of the discoveries—*le Comte-Amiral D. Vasco da Gama*—by the Countess Maria Telles da Gama. This book was read in manuscript by the regretted Luciano Cordeiro, who pronounced it the best monograph on the Admiral it was possible to write at this time.

A work on *Les premiers voyages Français à la Chine*, by Cl. Madrolle, contains much information on the Compagnie de la Chine, as well as reproductions of unpublished maps; and the new series of

the *Revue Coloniale*, which has resumed publication, is not to be overlooked.

It is a duty to recall the services rendered to geography by Dr. Ballay. From 1875 to 1884 he was engaged with Savorgnan de Brazza and Alfred Marche in the exploration of the Ogowe and the French Congo; alone, he traced the course of the Alima to its confluence to the Congo; and he shared with Captains Rouvier and Pleigneur, in 1884, the labour of surveying the frontier between the Congo Free State and the French Congo. In his subsequent career as an administrator he never lost his keen interest in the geographical progress of the French African Empire, of which he was, in the closing period of his life, one of the most justly distinguished Governors.

HENRI FROIDEVAUX.

NOTES AND NEWS.

THE DIVISION OF HYDROGRAPHY, U. S. Geological Survey, notes the loss of water in the southern course of the Rio Grande, through seepage in the wide, sandy bed, and it is estimated that by diverting water from the river in central New Mexico 150,000 additional acres of land could be irrigated.

A site for a reservoir is now under examination in a gorge just below the junction of Salt River and Tonto Creek, in Arizona. The capacity of the reservoir, with a dam 200 feet in elevation above the bed of the river, will be more than that of the great Nile reservoir. Materials are at hand for making cement on the spot for the construction of the dam, and the reservoir, when finished, will supply irrigation for nearly 200,000 acres of land.

Prof. C. S. Slichter, of the University of Wisconsin, has been studying the speed of the underflow in the sands of the Arkansas river. Two test wells are driven and electrically connected. In the up-stream well is placed an electrolyte, or dissoluble substance, which affects the electric current. This electrolyte enters the underground water at the first well and passes down stream to the second. In the circuit between the two wells the needle of an instrument records the approach and the arrival of the electrolyte, and by watching the needle it is possible to trace the movement of the water and the variations of its flow.

The rate of the underflow in the Arkansas river was found to be 3 feet to 15 feet per day.

Devil's Lake, in North Dakota, the largest body of water in the State, covers about 350 square miles. It is a glacial lake, and once had an outlet to the south into the Sheyenne river, through a well-marked empty channel. Observations for the last nineteen years show an almost uninterrupted sinking. Groves of trees, which once stood at the beach, are now separated from it by broad strips of sand, and the shallow parts of the lake, notably the long arms and bays, have been left quite dry.

Another change is in the water from fresh to salt; this has taken place within the memory of man, and is in some particulars producing unfavourable results. Fish were found in great abundance up to about 1888; now, practically none are caught.

The United States Geological Survey has established a bench-mark near the lake, and, under the charge of Prof. C. M. Hall, of the State Agricultural College, will make careful records of the fluctuations of the waters and a general study of their decline.

THE PEARY ARCTIC CLUB is now refitting the *Windward* for her summer voyage to the North. The ship is to be furnished with new engines and a new boiler of the most improved kind. The work will be completed by June 20, and the vessel will sail at once, that advantage may be taken of the conditions in Smith Sound, which are more favourable early in the season. The *Windward* will join Peary either at Etah, on the eastern side, or Cape Sabine, on the western side of Smith Sound.

THE BERLIN GEOGRAPHICAL SOCIETY has consolidated its two periodicals, the *Verhandlungen* and the *Zeitschrift*, in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, to be issued ten times a year, beginning with January, 1902. The new publication is a large octavo of 96 pages, and the first number contains an article by Dr. Karl Sapper, contributions to the Physical Geography of Honduras, with a valuable map on a scale of 1 : 1,000,000.

A COMMUNICATION from La Sociedad Científica Argentina, under date of January 19, announces the death of its Honorary Member and ex-President, Doctor Carlos Berg.

DECISIONS OF THE U. S. BOARD ON GEOGRAPHIC NAMES, JANUARY 8 TO APRIL 2, 1902:

AEKTOK: island, near west end of Avatanak island, Krenitzin group, eastern Aleutians, Alaska. (Not Aiaktak, Goloi, Goly, Ouektock, nor Rootok.)

AGAMGIK: bay, indenting the northern shore of Beaver Bay, Unalaska island, eastern Aleutians, Alaska. (Not Food.)

BATTERY: point, the eastern head of Sarana bay on south shore of Akutan island, eastern Aleutians, Alaska. (Not Kainak, Liberty Cap, nor South Head.)

BOSPORUS: strait between Black Sea and Sea of Marmora, Europe. (*Note.*—This is a reversal of the decision Bosphorus rendered by the Board, January 12, 1897.)

CHIWAWA: creek, Chehalis county, Washington. (Not Chi-wahwah.)

CURLEW: creek, lake, and P. O., Ferry county, Washington. (Not Karamin nor Karamip.)

FOREST: lake, in Woodbury, Orange county, N. Y. (Not Slaughter's Pond.)

GOOSMUS creek, Ferry county, Washington. (Not Goos nor Koosmus.)

HOWES: cave, in Cobleskipp, Schoharie county, N. Y. (Not Otsgaragee.)

HOWES CAVE: P. O., Schoharie county, N. Y. (Not Howecave, Howe Cave, Hows Cave, nor Howe's Cave.)

ILIULIUK: the chief town of Unalaska, eastern Aleutians, Alaska. (Not Unalaska.)

KISSELEN: bay, at the head of Beaver bay, Unalaska, eastern Aleutians, Alaska. (Not Kissialiak, Warsham nor Worsham.)

LEVASHEF: port or harbour at head of Unalaska bay, Unalaska, eastern Aleutians, Alaska. (Not Captains nor St. Paul.)

MARCY: mountain peak, the highest point in the Adirondacks, Essex county, N. Y. (Not Tahawus.)

MECHANICVILLE P. O. and village, Saratoga county, N. Y. (Not Mechanicsville.) (*Note.*—This is a reversal of the decision Mechanicsville rendered by the Board, April 4, 1900.)

RABBIT: creek, Ferry county, Washington. (Not St. Helen.)

SAMGANUDA: bay indenting the eastern shore of Unalaska, eastern Aleutians, Alaska. (Not English.)

SANPOIL: lake and river, Ferry county, Washington. (Not Rowena nor San Poil.)

SIGAK: cape, the north point of Akutan island, eastern Aleutians, Alaska. (Not North Head.)

ST. HELENS: mountain, in Skamania county, Washington. (Not St. Helen.)

ST. PETER: creek and flat, Ferry county, Washington. (Not Rock.)

ST. VRAIN: creek and precinct, Weld county, Col. (Not St. Vrains.)

TANASKAN: bay, indenting the southern shore of Beaver Bay, Unalaska, eastern Aleutians, Alaska. (Not Macks nor Taneska.)

TANGIK: islet, near the eastern shore of Akun island, Krenitzin group, eastern Aleutians, Alaska. (Not Waverly.)

TANGINAK: islet, east of Akun island, in Unimak pass, Alaska. (Not Breed nor Propagation.)

TERODA: creek and mountain, in Ferry and Okanogan counties, Washington. (Not Tarrota nor Toroda.)

UGALGAN: island, near the easternmost point of Unalaska, eastern Aleutians, Alaska. (Not Egg, Gagalgin, Iachnoi, Jaitschoi, Kigalgin nor Orieshik.)

UNALASKA: bay, indenting the northeastern shore of Unalaska island, eastern Aleutians, Alaska. (Not Captains.)

URILIA: bay, on the northern coast of Unimak, eastern Aleutians, Alaska. (Not Shag nor Shaw.)

USOF: bay, indenting the southeastern shore of Unalaska, eastern Aleutians, Alaska. (Not Whalebone.)

WALLKILL: river, in Ulster and Orange counties, New York. (Not Wall Kill.)

WITCHCOAT: point, Back river, Baltimore county, Md. (Not Witchcoate.)

OBITUARY.

Egbert L. Viele.

Gen. Viele died at his home in this city on the 22d of April. He was apparently in good health during the day, but was taken ill soon after retiring at night, and died in a few minutes.

He was born in Waterford, N. Y., June 17, 1825. He was graduated from West Point in 1845, and served in the Mexican War and in Indian campaigns. He resigned from the army in 1850 with the rank of lieutenant, and became a civil engineer in this city. He was State engineer of New Jersey from 1854 to 1856, when he was appointed chief engineer of Central Park. He prepared the plan which was adopted for the Park.

In the Civil War he joined the army at the first call for volunteers, and commanded the force which opened the Potomac river to Washington. He was Captain of Engineers of the Seventh Regiment of New York, and was commissioned Brigadier-General of Volunteers in 1861. He took part in the Port Royal expedition and the capture of Fort Pulaski, and for a time was military governor of Norfolk, Va.

Later he resigned from the army and resumed his work as a civil engineer. He was Commissioner of Parks and President of the Park Commission in this city, and in 1885 was elected to Congress.

Gen. Viele appeared in 1896 before the Committee of the British House of Lords to speak on municipal administration. He was, for many years, interested in Harlem river improvements, and in the improvement of the upper west side of the city.

He was the author of "A Handbook for Active Service," and of a topographical atlas of the City of New York.

Gen. Viele became a Fellow of this Society in 1854. He was a member of the Council from 1856 to 1860, and again from 1879 to 1900; and he was one of the three Vice-Presidents from 1888 to 1900.

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Interoceanic Communication on the Western Continent. A Study in Commercial Geography. (From the Geographical Journal, for March, 1902.) Paper, 8vo.

From George Davidson, Author:

The Tracks and Landfalls of Bering and Chirikof on the Northwest Coast of America, June–Oct., 1741. (Private Publication), San Francisco, 1901. Paper, 8vo.

From Emil S. Fischer, Author:

The Expansion of American Banking in the Far East. (Reprinted from The Bankers' Magazine, January, 1902.) New York. Paper, 8vo.

From Adrian H. Muller & Son, New York:

Map of the City of New York and Island of Manhattan, as laid out by the Commissioners appointed by the Legislature, April 3, 1807. Wm. Bridges. Engraved by P. Maverick. New York, 1811. 8 ft. x 2 ft. 5 in. *Framed in walnut.*

Twenty-six maps of New York City Real Estate, in board covers; various dates.

From J. de Rey-Pailhade, Author:

Unification des Mesures Angulaires pour les Cartes de l'Armée de Terre, et pour les Cartes de la Marine. (Supplément au Bulletin de la Soc. de Géographie de Toulouse, No. 5, 1901.) Toulouse, 1901. Paper, 8vo.

From Chandler Robbins:

A History of the Bank of New York, 1784–1884. By Henry W. Domett. 3d edition. (Boston and New York, Houghton), s. a. 8vo.

BOOK NOTICES.

Irrigation in the United States. By Frederick Haynes Newell. 417 pp Thomas Y. Crowell & Co. (In series, Library of Economics and Politics.)

Mr. Newell is Chief of the Division of Hydrography of the United States Geological Survey, and is exceptionally fitted to prepare a work on irrigation. This subject now appeals scarcely less to any citizen of broad views than to the actual dweller in the arid regions. This fact finds typical expression in the sentence quoted upon the title-page of this volume, from President Roosevelt's first message: "The forest and water problems are, perhaps, the most vital internal questions of the United States." As set forth in the author's preface, he has prepared a non-technical and popular account of the use of water in irrigation.

Home-making is the avowed object of the book, and the size of the problem appears in the fact that one-third of the United States, apart from Alaska, is still public land. The reclaiming of these vast areas is of equal interest to East and West, because of the increased manufacture and transportation involved in the doubling or quadrupling of the Western population. A hundred homes of independent farmers are better than one or two great stock ranches owned by non-residents. Most of the vacant land, subject to the homestead law, is arid, and settlers cannot afford to take it up, because the expense of conveying the available water is too great for them to bear. The smaller streams are already bordered with farms, and the settler can no longer construct his own simple system of irrigation. Further, the rectangular plots laid out by the Government surveyors serve well upon the smooth and uniformly-watered prairies, but are quite unsuited to the arid country, where each area is dependent on adjacent territory for its water supply, and the control of a small tract along the streams carries practical ownership of thousands of acres of upland.

Chapter II gives an account of the arid regions. The interesting fact appears that the amount of annual rainfall does not alone determine the need of irrigation, but its distribution throughout the year is equally important. Thus, parts of California which have more than twenty inches annually may need irrigation, because the precipitation is large in winter and almost nothing in the summer. At

Santa Fé, on the other hand, the annual total is smaller; but the rain comes mainly during the summer months, when needed by crops. Only about seven per cent. of the arid region can properly be called desert. All the rest bears scanty vegetation, which is of value to man. This chapter also discusses the relations of the forest regions, and of grazing on the public domain, to irrigation.

The three following chapters treat of Surface Waters, Conveying and Dividing Stream Waters, and Reservoirs. Surface streams supply water for ninety per cent. of the irrigated lands. The underground waters are, however, an important and, in some places, an essential resource. The flow of surface-waters in the arid regions fluctuates in a manner unknown in humid districts, and such irregularity gives great importance to stream measurements, such as are carried on, under the author's direction, by the Division of Hydrography. Considerable space is given to an explanation of the methods and apparatus used in determining the amount of flow in streams. The laying out of canals and ditches is described, with the devices used for apportioning water from a single ditch among several consumers. It is not always possible to follow natural grades around depressions, and here the trestle and flume, or the inverted siphon, is used. In some cases canals are lined with cement, to prevent loss by percolation. Too great fall in the ditches leads to their destruction by the stream. In sluggish water aquatic plants may become a disturbing factor. A case is cited from Arizona in which the muds carried over the land by irrigating waters were deemed to have a fertilizing value of $8 per acre.

Some of the points emphasized in the making of reservoirs are: good assurance from stream measurements that the supply is adequate; certainty from the surveys of the reservoir site that it will hold a sufficient body of water; and absolute security in the construction of the dam.

Other chapters discuss the methods of applying water to the fields, underground waters, and pumping. Chapter IX follows, upon the advantages and disadvantages of irrigation. While it has inherent difficulties, calling for patience, intelligence, and experience, it promotes more varied agriculture, proximity of homes, and greater personal and family thrift and wealth. Intensive farming by closely-populated communities thus stands over-against the isolated farmer depending on a single crop.

A short account of irrigation law is given, and the rest of the volume is chiefly devoted to the several groups of States, classified as arid, semi-arid, and humid. The arid States and territories are:

Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. This, of course, is a broad statement, not taking account of well-watered areas in some of these States. Of their lands, somewhat more than 4,000,000 acres were irrigated in 1890, and more than 7,000,000 in 1900. California leads with 1,200,000 acres, and Colorado follows with 1,000,000. Montana is third, with 380,000. It is believed that there is water enough in these States to irrigate 60,000,000 acres.

Some significant comparisons are made of our sparsely-peopled Western regions with densely-populated Old World empires of equal size. In a similar way an outline map of California is turned around and superimposed upon our Atlantic coastal region, where it stretches from southern New York, beyond Charleston, into Georgia. This great State is peculiarly dependent on irrigation for the richest products of its soil. The orange product of Southern California in 1899 was valued at $7,000,000.

The volume is an authoritative exposition of a subject which is of especial interest because of proposed Federal legislation now under discussion. A. P. B.

The Alasko-Canadian Frontier. By Thomas Willing Balch, A.B. (Harvard), Member of the Philadelphia Bar, The American Philosophical Society, The American Historical Association, etc. Read at the Annual Meeting of the Franklin Institute, January 15th, 1902, and Reprinted from the "Journal of the Franklin Institute" for March, 1902. Philadelphia, Press of Allen, Lane and Scott, 1902.

In this handsome volume of 45 pages, Mr. Balch gives the record of the frontier line between Alaska and the British possessions since the year 1825. The facts tell their own story, as summarized by Mr. Balch:

> The English and the Canadian Governments, through their official representatives, have again and again recognized the claim of Russia down to 1867, and since then that of the United States, that the area of Russian America, or Alaska, comprises an unbroken strip of territory on the continent, extending from Mount Saint Elias in the north to the Portland Canal in the south; that this strip of land encircles all the sinuosities of the shore; and that by this strip the Dominion of Canada is cut off from all contact with the indentations of the sea along the northwest coast of the continent between the Portland Canal at about fifty-four degrees forty minutes, north latitude, and Mount Saint Elias. (*Page 31.*)

Eight maps illustrate the text. No. 1 gives the United States and English Boundary Claims; No. 2, Sir C. Bagot's Three Proposed Boundaries, 1824; No. 3, Imperial Russian Map, Dressé par M. de Krusenstern, Contre-Amiral * * * publié par ordre de Sa

Majesté Impériale, Saint Petersbourg, 1827; No. 4, "Carte Générale * * * de la Côte N. W. (*sic*) de l'Amérique," prepared at St. Petersburg in 1829 by Functionary Piadischeff," au Dépot Topographique Militaire"; No. 5, Canadian Map of 1831, "Compiled * * * by Joseph Bouchette, Jr., Deputy Surveyor General of the Province of Lower Canada"; No. 6, Map in "Narrative of a Journey Round the World," by Sir George Simpson, London, 1847; No. 7, Map of the Hudson's Bay Company: "Ordered by the House of Commons to be printed July 31st and 11th August, 1857." The Russian Territory, which is darker than the Canadian in this reproduction, is colored yellow on the original map; and No. 8 gives the British Admiralty Chart, published June 21st, 1877, under the Superintendence of Captain F. J. Evans, R.N., Hydrographer, and corrected to April, 1898.

In a foot-note on page 31, Mr. Balch says:

> I bought the copy of this chart, from which map No. 8 is reproduced, at Edward Stanford's, 26 and 27 Cockspur, Charing Cross, S. W., London, in September, 1901, showing that up to that date at least the British Admiralty agreed with the United States as to the frontier.

The Mastery of the Pacific. By Archibald R. Colquhoun, Gold Medallist Royal Geographical Society; Silver Medallist Society of Arts; Formerly Deputy Commissioner, Burma; Administrator of Mashonaland, South Africa; and Special Correspondent of the "Times" in the Far East. Author of "China in Transformation," "The 'Overland' to China," etc. With Special Maps, Frontispiece, and more than One Hundred Illustrations from Original Sketches and Photographs. New York, The Macmillan Company, London: Macmillan & Co., Ltd., 1902. All rights reserved.

Mr. Colquhoun knows the East, and is always ready to impart his knowledge. What he did not already know of the Far East he undertook to learn in 1901, and the present volume is creditable to his industry.

The title of the book is somewhat misleading. Mr. Colquhoun does not make it clear to his readers that there is such a thing as the mastery of the Pacific, though he seems to hint that the Anglo-Saxons (meaning, apparently, the Americans, the British, and the Japanese) will find their way towards naval supremacy in the Great Ocean. *Todo puede ser*, and one man may see as far into the future as another; though it is not given to every man to prophesy. It is

safe to say that naval supremacy in the Pacific is a rhetorical flourish which does not widen the bounds of knowledge, even in rhetoric.

The real value of Mr. Colquhoun's work is in a portion of its main object, as set forth in his preface:

> to present a vivid impression of the various countries—their peoples, scenery, social and political life, and the parts they are destined to play in the great drama of the mastery of the Pacific.

Considered as records of travel in strange countries, many of the chapters justify themselves; but nearly 100 pages, of the whole 430 in the volume, are devoted to the Philippine Islands and their population, and the reader, while he finds himself interested in the story, is at a loss to understand what the Filipinos have to do with the mastery of the Pacific. Mr. Colquhoun does not explain the riddle. It may be that while he writes of Philippines and Filipinos his thoughts are busy with the United States and the Americans.

The book is rather too heavy, but it is handsomely printed and abundantly illustrated.

La Lettre et la Carte de Toscanelli sur la route des Indes par l'Ouest, adressés en 1474 au Portugais Fernam Martins et transmis plus tard à Christophe Colomb. Étude Critique sur l'authenticité et la valeur de ces documents et sur les sources des idées cosmographiques de Colomb suivie des divers textes de la lettre de 1474, avec traductions, annotations et fac-similé, par Henry Vignaud, premier secrétaire de l'Ambassade des États-Unis, Vice-président de la Société des Américanistes de Paris, etc. Paris, Ernest Le Roux, Éditeur, 28, rue Bonaparte, 1901.

M. Vignaud's book is an extract, developed and completed by several appendices, of a work on which he has been engaged for more than twenty years.

He has seen reason to doubt the authenticity of the famous Toscanelli letter, and he presents in this work the conclusions at which he has arrived after impartial examination of the testimony, if testimony it can be called.

M. Vignaud admits, without hesitation, that his conclusions have only a hypothetical character.

1. Toscanelli, he thinks, never wrote to the Canon Martins nor to Columbus;

2. Columbus knew nothing of the letters and the map attributed to Toscanelli;

3. The story of the unknown pilot (by some called *Antonio*

Sanchez), who discovered the Antilles and informed Columbus of their existence, M. Vignaud believes to be true;

4. The letter to Martins and the map were fabricated to show that the discovery made by Columbus was the outcome of a scientific theory approved and suggested by a great savant.

5. The fabrication was the work, not of Columbus, nor of his son Ferdinand, but, probably, of his brother Bartholomew;

6. The documents must have been fabricated after the death of Columbus. They were made known for the first time between the years 1547 and 1552.

If these statements are not susceptible of proof, it is equally true, in M. Vignaud's opinion, that no one can prove the genuineness of the Toscanelli letter. This may be admitted, without accepting as a consequence the legend of the pilot, who told Columbus of islands which he had discovered. One obvious objection to this legend does not seem to have occurred to those who accept it. Is it to be supposed that an obscure seaman, who had made such a discovery, said nothing when he returned, but kept the matter a profound secret to be told in confidence to Columbus?

M. Vignaud, and those who agree with him, would have us choose between Toscanelli's letter and the story of the pilot Sanchez. Both may be left out of the question. Columbus himself counts for much more than any number of pilots and letters, and M. Vignaud's well-considered work leaves an impression of something very like beating the air.

TRANSACTIONS OF THE SOCIETY.

MARCH–APRIL, 1902.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, March 18, 1902, at 8.30 o'clock P.M.

Vice-President Tiffany in the chair.

The following persons, recommended by the Council, were elected Fellows:

Dr. Joaquin Yela.
William J. Wilgus.
Garrett B. Linderman.
Charles H. Cramp.
Charles S. Mellen.
Clarence F. Wyckoff.
F. S. McGraw.
B. N. Baker.
Elihu Thomson.
Charles M. Schwab.
H. C. Mandeville.
John Burling Lawrence.
Chas. H. Taylor, Jr.
Duane H. Church.
Norman B. Ream.
Henry D. Holton.
John Carleton Baker.
Louis J. Nicolas.
Mortimer L. Schiff.
Edward G. Acheson.
Robert L. Wensley.
John Skelton Williams.

The Chairman then introduced the speaker of the evening, M. Hugues Le Roux, who described in French his visit to the Emperor Menelik. Illustrations were shown on the screen.

On motion, the Society adjourned.

A Regular Meeting was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, April 15, 1902, at 8.30 o'clock P. M.

Vice-President Tiffany in the chair.

The following persons, recommended by the Council, were elected Fellows of the Society:

Frederick H. Hedge.
Daniel Rogers Noyes.
Hanford N. Lockwood.
Rev. William G. W. Lewis.
Frederick Taylor.
Rev. M. A. Matthews.
Emil Winter.
W. Beaumont Whitney.
Charles F. Brooke.
Harry H. Laughlin.
Dr. E. Fayette Smith.
Samuel Rea.
E. R. Case.
Rev. Dr. Alfred G. Mortimer.
John C. Thompson.
Frederick A. Constable.
Juan J. Ulloa G.
James Isaac Buchanan.
Eckley B. Coxe, Jr.
Henry Barton Jacobs, M.D.
Edward Barr.
James H. Parker.
Albert C. Burrage.
Lawrence C. Phipps.

The Chairman then addressed Dr. A. Donaldson Smith, who, by invitation, occupied a seat upon the platform, and summarized the story of his explorations in Eastern Africa and beyond Lake Rudolf to the Nile; explorations conducted in a truly scientific spirit and resulting in marked additions to the knowledge of the world. In recognition of the qualities displayed and the results achieved, the Council had unanimously awarded to Dr. Smith the Cullum Geographical Medal, and this it was now the Chairman's privilege to present to him.

Dr. Smith, in returning thanks, expressed his deep sense of the honour conferred upon him and his peculiar gratification at receiving such a mark of distinction from the oldest geographical society of his native land.

The Chairman then introduced Mr. Carl Lumholtz, who delivered a lecture on the Huichol Indians, of Mexico.

Stereopticon views were shown.

On motion, the Society adjourned.

REPORT OF THE AUDITING COMMITTEE.

NEW YORK, February 14, 1902.

To the Council of the American Geographical Society:

We have examined the accounts of the Treasurer for the year ending December 31, 1901, compared them with vouchers and find the same correct in every particular. The cash balance on hand on the 31st of December was $10,460.35.

We have also examined the securities belonging to the Society which are deposited in the Safe Deposit Vaults of the Bank of New York, and find them to be fifteen Bonds secured by mortgages on property in New York City and its vicinity, amounting to $96,750, all fully guaranteed by solvent Trust Companies.

Of these bonds $5,000 pertain to the Cullum Geographical Medal Fund, and $5,000 to the Charles P. Daly Medal Fund.

Signed. FRANCIS M. BACON,
" S. NICHOLSON KANE,
Auditing Committee.

In March, Mrs. George A. Leavitt presented a marble bust of her father, the late James Ewing Cooley, a Fellow of the Society for the years 1856–1883.